VELPEAU'S

ANATOMY OF REGIONS.

TRANSLATED FROM THE FRENCH.

BY

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In preparing the following Treatise, it has been my desire to furnish the Student with a complete Work on the Anatomy of Regions, restrained within such limits as would make it available to all Members of the Profession. This will account for the omission of the Plates, and that portion of the original which treats of General Anatomy. It has, also, been my endeavour, whilst I rendered the translation as literal as the various idioms permitted, to give the descriptions as clearly and simply as possible: if I have succeeded, I am satisfied.

HENRY HANCOCK.

Harley Street, 1st Feb. 1838.

ANATOMY OF REGIONS.

CHAPTER FIRST.

OF THE TRUNK.

The trunk is composed of four principal portions; the head, neck, chest, and abdomen. Considered as separated from the extremities, its greatest diameter is at the middle of the thorax, or, in some females, at the pelvis. In general a little flattened, its four planes incline more or less towards the neck. Its length, comprehending about half of the entire height of man, varies much less than that of the extremities. The difference in this respect is so great, that the trunk of an individual of four feet and a half high, frequently, equals that of a tall man.

The *skin* is commonly covered with hair on the anterior region of the trunk, and the lower portion of the pelvis. Increasing in thickness, as it proceeds, posteriorly, from the ribs, it thus explains why furuncula and anthrax are so frequent on the back.

Protected by the garments from the action of the atmosphere and rays of light, it is naturally less coloured than that of the face and other exposed parts; but this also depends, in a great measure, upon the comparatively small number of vessels it receives; a circumstance which, in some degree, enables it to resist the attacks of inflammation and erysipelas.

The *subcutaneous tissue*, thin and purely lamellated in some points, is thick in others, and occasionally filamentous. It is, therefore, subject to all the varieties of phlegmonous and erysipelatous inflammations; and being covered with very strong and thick integuments, its abscesses often acquire considerable magnitude. The arteries, veins, and nerves are entirely unimportant; consequently, wounds and operations are never succeeded by hemorrhage, nor neuralgic affections.

The *superficial fascia* and aponeuroses vary so much in density, that the division of inflammations and abscesses, into superficial and deep, is not equally practicable at all points.

Although some of the *muscles* of the trunk (the recti muscles of the abdomen and neck, for instance,) have sheaths, yet many are without. Their flattened or ribbon-like shape prevents their direction being distinguished externally; but incisions in

them are comparatively free from danger, from the extent to which their deep surfaces adhere to the skeleton.

The *vessels* and *nerves* form two classes. The former ramify on the surface, or in the substance, of the walls of the visceral cavities, and being rarely of any magnitude, the only inconvenience resulting from their division is the difficulty experienced in exposing and securing them, in the substance of the muscles. The latter, situated within the cavities themselves, are of great size, and give rise to considerable apprehension in severe penetrating wounds.

The *skeleton of the trunk*, composed, superiorly, of a solid cavity, inferiorly, of a kind of girdle, in the middle, of bony and cartilaginous arches, completed between the ribs, from the chin to the sternum, and from the ensiform cartilage to the pubes, by soft parts, is formed, in a great measure, by the spine, situated, posteriorly, in the median line.

The *vertebral column* serving as a pivot for the rest of the body, sustaining the weight of all the other portions, situated between the numerous and powerful muscles which retain it, posteriorly, and the whole of the viscera which draw upon it, anteriorly, is naturally predisposed to contract the different diseases common to the osseous system. The spongy nature of the bodies of its bones, the number and size of their veins, the extent of their cellular and medullary membranes, fully explain the frequent occurrence of ramolissement, suppuration, caries, necrosis, and consequent gibbosity and curvature. Its periosteum and ligaments being very elastic, and continually upon the stretch, easily become inflamed; thence the origin of superficial caries and abscesses, arising from congestion.

The intervertebral fibro-cartilaginous pads are much stronger than analogous substances at other parts of the body; and so firmly are they attached to the vertebræ, between which they are placed, that they rarely separate, without dragging away a portion of bone with them.

The other articulations of the spine are not sufficiently mobile, or complicated, to require a separate description. The direction of their spinous and transverse processes, the power of their yellow ligaments, joined to the predisposition already mentioned, render their luxation almost a matter of impossibility, and their fracture extremely difficult.

The canal containing the cord, the origin of nearly all the nerves of locomotion, cannot undergo any extensive alteration of form without causing symptoms of paralysis; consequently, this is the result most to be dreaded from luxation, fracture, curvature, or tumours extending into its interior. This canal, continuous with the cavity of the cranium, invested by very fine cellulo-adipose tissue, large veins, long bands of ligament, and the three membranes of the cord, is easily implicated in surrounding inflammations, which penetrate and rapidly involve

its whole extent. It equally allows pus and other liquids to collect, which becoming diffused, and reaching the brain, cause almost instantaneous death.

Protected anteriorly, in a great measure, by the bones themselves, against the action of the viscera, posteriorly, by the vertebral lamellæ and articular processes, the spinal marrow can scarcely be injured, unless the continuity of its bony canal be destroyed.

The same may be said of the nerves, whilst in the intervertebral foramina; but the position of the aorta, anteriorly, explains how aneurisms may compress the spinal marrow, after causing absorption of the intervening bones.

As the whole of the movements of this part depend upon the *multifides spinæ* muscle, or the fleshy mass filling up the vertebral groove, it is the principal agent in the various malformations which occur. Attached to the tubercle of the articular processes, inferiorly, and near the angles of the ribs, superiorly, its external portion, the *longissmus dorsi*, cannot act without drawing the body backwards; at the same time, uniting with the *sacrolumbalis* (which also acts upon the spinous processes), it causes lateral curvatures whenever there is a tendency to mollities ossium. These muscles, moreover, are so thick and so compressed against the bones, that the vertebral canal is completely guarded.

The depth of the vertebral canal, its relation with the preceding muscles, and the inequalities of its posterior region, render access to it extremely difficult. On this account Messrs. Tyrrell and Cline have been much blamed for trephining on this part, for the purpose of removing fractured portions of bone. This, however, did not prevent Smith, of America, from excising portions which had for several years caused compression of the spinal marrow; and, consequently, as there are neither arteries, veins, nor nerves of any importance, and only muscles to be cut through or displaced, Tyrrell's operation should be essayed in those accidents where there is evident depression, and consequent pressure upon some one point of the cord.

This succinct analysis of the constituent elements of the trunk explains how the slightest injuries may lead to the most serious consequences, from the inflammation and pus penetrating from the exterior to the interior of the vertebral column. The cellular tissue and small vessels render this accident of still more frequent occurrence in the cranium, thorax, and abdomen. The importance of the organs contained in these large cavities naturally alarms us for the consequences of wounds penetrating them; although one of the first portions distinguishable in the fœtus, the vertebral column, is one of the last which attains perfection after birth. As its anterior cylindrical portion offers great solidity from the commencement, it is habitually,

posteriorly, in the direction of its protecting arches (which never close until a later period), that tumours proceeding from the canal present themselves. When the membranous sheath in which the marrow is developed becomes filled and distended by serum, the lamellæ will not only remain incomplete, but may even disappear altogether, if this distension increases after the formation of their temporary cartilage. It is thus that the spinal canal becomes reduced to a mere gutter, either in one portion, or in its whole extent, producing *spina bifida*. The adipose cellular tissue, external to the dura mater, becoming the seat of fatty or hydatid tumors, may be mistaken for this latter affection, producing groundless fears, and preventing resort to the proper means of cure.

SECTION FIRST.

OF THE HEAD.

The cephalic extremity of the trunk, composed of the cranium and face, surmounts the spine in such a manner, that it requires the continual effort of the muscles situated in the posterior cervical region to prevent its falling forwards.

The size of the head, the importance of the organs which it encloses, the numerous pieces of which it is composed, sufficiently explain the frequency of its affections, and the number of operations practised upon it. Very distinct and large during the early period of utero-gestation, it may increase too rapidly, or otherwise, in its whole extent or in part; whence, a certain number of monstrosities, either from malformation through excess of organization, or from arrest of developement. The brittleness of its tissue allows of its separation from the body, and, doubtless, this is the origin of acephaloids. The fœtus, depending upon the cord for its existence, may be deprived of the head, neck, and even a portion of the chest, by their insensibly dissolving in the liquor amnii, without the rest of its developement being interrupted. Among the facts which I have observed, there are several which appear to me to place the justice of this view of the question beyond a doubt, and prove that we should, in a great number of monstrosities, attribute the malformation to it, rather than to any arrest of developement. A little later, after the third month, the softness of its bones, and the tenuity of its membranes, permit its being moulded to any form, or compressed or elongated, without danger, and of its being returned to its proper shape after birth.

CHAPTER SECOND.

OF THE CRANIUM.

The cranium forms at least two thirds of the head. It is continuous with the spine, of which it is considered, by some anatomists, as being merely an increased developement, composed of numerous vertebræ. More regularly oval than the head, being longer posteriorly than anteriorly, both in its vertical and transverse diameter, it is naturally most liable to fractures in the former. Externally, its anterior portion belongs to the face. The whole of its inferior surface, or base, is concealed by the face, and the superior extremity of the neck, with which it unites. Internally, it presents a cavity, the vault or roof of which, invested by dura mater, folding in upon itself, in the median line, forming the *falx cerebri* and *cerebelli*, and afterwards, horizontally, the *tentorium cerebelli*, is traversed by various grooves, either for sinuses or arteries, and presents irregularities, corresponding to the convolutions of the brain.

Its base, divided into three fossæ, the *orbito-ethmoidal*, *spheno-temporal*, and *occipital*, is perforated by openings, for the passage of nerves and vessels. Its position, and the nature of the bones composing it, render it the common seat of fractures of the head from percussion. As it is quite incompressible, the reduction of its diameters during labour should never be attempted. From its relation to the base of the brain, and the nerves arising from it, exostosis and all other diseases are incomparably more dangerous here than in the vault of the cranium.

The hair, which covers the greater portion of the cranium, interferes in the treatment of its wounds, either by getting between their edges, or by adhering to the plasters, causing irritation at each dressing. It is therefore necessary, that, in all cases of wounds of this part, the integuments be carefully shaved, which allows the sutures to be traced, and facilitates the diagnosis of fractures. This portion of the head presents three regions; the frontal, temporo-parietal, and the occipital, which we will now, successively, examine.

SECTION FIRST.

FRONTAL REGION.

Externally, each frontal region presents a transverse depression, and in the centre a rounded prominence, receiving the names of frontal *protuberance* and *depression;* more inferiorly, another depression, which is triangular, and descends between the eyebrows to the root of the nose; internally, the veins,

and their branches; superiorly, the hair, the extent of which varies in different individuals.

The skin of the forehead, in both sexes, is thin and smooth during infancy, and the earlier periods of life, but it frequently becomes marked by transverse wrinkles, at its inferior portion, in more advanced age.

Superiorly, and externally, it is smooth and thicker, containing the bulbs of the hair, and numerous sebaceous glands. The hair generally pierces it obliquely, forwards and outwards, whence its tendency to follow one or the other of these directions, as it descends towards the face.

The *cellulo-adipose tissue*, situate between the occipito-frontalis muscle and the skin, is commonly very thin anteriorly; its structure is dense and compact, having the adipose cellules closely applied one to the other, especially opposite the temples, where they sometimes form a thick lamella. The intimate union of this membrane with the two layers between which it is placed, explains why wounds of the integuments at this situation are accompanied, so frequently, by erysipelatous inflammations, and why tumours are ordinarily circumscribed, globular, or flattened. In all cases, as the subcutaneous layer of the forehead becomes thinner inferiorly, ecchymosis often proceeds to a great extent at the side of the orbits. Finally, the roots of the hair, and sebaceous follicles, are contained within it.

Muscles and aponeurosis.—The muscles of the frontal region are, inferiorly, a very small portion of the orbicularis palpebrarum, more superiorly, the occipito-frontalis, thicker in the middle and inferiorly, where it covers the whole of the bone. The fibres of this latter, being parallel, produce in contracting the transverse wrinkles of that region. It appears, moreover, that they are developed on the epicranial aponeurosis, which is thin and cellular beneath.

Superiorly, and posteriorly, the aponeurosis is strong and fibrous, and is with great difficulty separated from the subcutaneous layer; as, on the contrary, these unite to the pericranium, externally and inferiorly, through the medium of very loose cellular tissue, pus and other formations infiltrate and spread between them, instead of becoming circumscribed tumours. This peculiarity should be borne in mind, when we would determine the nature and danger of diseases attacking the frontal regions.

The *pericranium* presents nothing of any importance in this region. We have already observed its relation with the muscle; it is united to the bone by cellular tissue, which is rather lamellous than filamentous, so that it may be easily separated from the skull, in those points where there are no sutures.

The *arteries*, branches of the supra-orbital, the trunk of which is, at first, situated between the orbicular and frontal muscles, ramify in the subcutaneous layer; the anterior division of the

superficial temporal also forms numerous anastomoses with the preceding. Their investing membrane is so compact, that there is difficulty in securing and tying them; compression, therefore, is preferable to the ligature; but if we are constrained to employ the ligature, on account of the acute pain caused by compression, or otherwise, the tenaculum will be found the most convenient instrument. In the pericranium, we only meet with the minute capillary branches of the *deep temporal veins*. Internally, near the median line, is situated the facial vein, which is sometimes wanting, or, on the contrary, there are occasionally two or three. As it is sometimes very large, in old people, the ancients frequently opened it in diseases of the head. It appears to me, that this operation is too much neglected in the present day, for, in fact, this vein carries the blood, from the anterior half of the cranium, to the root of the nose. Phlebotomy here, therefore, has the immediate effect of emptying the vessels of the scalp. Situated between the dermis and the cellulo-adipose layer, this vessel is unaccompanied by any artery, and can, therefore, be attained without danger to any organ of importance. The other veins accompany the arteries, and present nothing remarkable; and it need only be observed, that some of them traverse the frontal and fronto-parietal sutures, to empty themselves into the longitudinal sinus. They are generally small, and, possessing no valves, may serve for the abstraction of blood, from the interior of the cranium, if cupping glasses or leeches are applied upon corresponding points. It was for this reason that Santorini named them *emissary veins*.

The *lymphatics* are but few, and as yet little understood. They pass into the parotid glands; thus, diseases of the frontal region, in some instances, are accompanied by swelling of the glands, in the neighbourhood of the ear. There are, moreover, some few situated in the face, which may, under similar circumstances, cause swelling of the sub-maxillary gland.

The *nerves* are derived from the *fifth* pair and the *facial*. The *internal frontal* branch, piercing the epicranial aponeurosis, ramifies in the muscle, p[illegible] in the inner half of the region. The *external fro*[illegible] *perciliary* branches, on the contrary, spread in the [illegible]uro[illegible] of the one part, and in the pericranium of the o[illegible] that their form is flattened. Ramifying, principally, t[illegible] the temple, they anastomose with some twigs of the facial, [illegible]r the e[illegible]ernal orbital process, whilst, posteriorly, they unite [illegible] the [illegible]erficial temporal, derived from the auricular branc[illegible] the in[illegible]ior maxillary.

The *skeleton*, in this re[illegible] only [illegible]mprehends the convex, or cranial, portion of the os [illegible]s.

The external orbital p[illegible]s, ea[illegible] fractured on account of its prominence, is situated [illegible]xternall[illegible] and gives origin to the semicircular line of the te[illegible] fo[illegible] In some instances, there

is a vein situated in its substance; consequently perforation of the cranium at this point may cause considerable hemorrhage. Internally, corresponding to the median line, is the nasal prominence, more developed in adults and old men than in women and children; thus, in the latter the forehead is more uniform, and the root of the nose less sunken. An oblique fissure from below, upwards and outwards, separates it from the *supra-orbital* arch. The superciliary prominence forms the anterior wall of the frontal sinuses. As these sinuses are invested by a membrane which communicates with the nares, muco-puriform or other matter may by chance pass from the nose through an accidental opening in the forehead, and lead to the belief that it flows from the cranium. Another mistake may also occur, from discharge of pus, possessing the character of brainy matter, from the sinus into the nose. From its communication with the nasal fossæ, and the character of its secretions, wounds and other diseases perforating the anterior wall commonly give rise to fistulæ, which are with difficulty cured.

In consequence of the unequal separation of the two lamellæ of the frontal sinuses, we should, as far as possible, avoid trephining over them, as the crown of the instrument may wound the meninges, or the brain itself, before the perforation of the bone is completed; nevertheless, in cases of necessity, the cranium may be perforated in this situation, without injury to its membranes, by taking the precaution of sawing the first bony layer with an instrument having a [illegible]ger crown, and the second with a smaller, as was the pract[illegible] M. Larrey. We should also note, with regard to the [illegible] that, in some instances, the frontal sinuses extend [illegible] e external orbital processes, or, posteriorly and [illegible] r as the parietal bone, whilst in others they ar[illegible] dispositions prevent a correct judgment [illegible] ize of the anterior portions of the b[illegible] cranium. When fluids collect [illegible] hese sinuses, their posterior lam[illegible] rst, quickly causing pressure [illegible]

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Relat[illegible] gement we find, fr[illegible]

1. T[illegible]

2. A [illegible] rincipal vessels.

3. T[illegible] rcilii, and

frontal muscles, or the aponeurosis, grooved by the internal, and some branches of the external, frontal nerves.

4. The pericranium, and branches of the latter nerve.

5. The frontal bone.

6. The dura mater, and the apex of the brain.

7. In the median line the root of the nose, afterwards deeper seated, the frontal crest, and the falx cerebri, which should be carefully avoided in trephining. As there are no arteries of any consequence situated between the bone and the dura mater, there is no fear of hemorrhage in operations performed upon the forehead. It should, moreover, be understood, that one of the frontal eminences may be more prominent than the other, and lead to the presumption of fracture; the arterial or nervous grooves being deeper than usual may also tend to the same error. These two peculiarities were met with in the same subject, in Dec. 1831, at the Hôpital de la Pitié. The man had one of the frontal eminences sensibly depressed and obliquely grooved by a very evident fissure; the post-mortem examination proved that he had a fracture also, but not at this point.

SECTION SECOND.

TEMPORO-PARIETAL REGION.

Externally, between the ear and the frontal region, above the zygoma, is situated sometimes a convexity, sometimes a hollow, according to the stoutness of the subject and the size of the temporal muscle. Above the *temporal fossa* we find a rounded, large, and regular eminence; this is the *parietal prominence.*

The *skin* is very thin, elastic, and adheres but slightly through the whole of the lower part of this region. Anteriorly to the ear, approaching the external orbitar process it adheres more intimately to the adipose layer; it is free from hair. Posteriorly, and superiorly, it gradually becomes thicker, and assumes a character similar to that of the superior portion of the forehead. The hair with which it is covered penetrates it obliquely, so that those in the middle descend towards the ear; those anteriorly, on the side of the face; and the posterior, towards the neck. They become grey here sooner than elsewhere, whence the name *temples* (*tempora*).

Inferiorly, the *cellulo-adipose* layer lies upon a dense fibro-cellular membrane, which is thickest posteriorly, supporting the three *auricular* muscles. This latter may be considered as the superficial fascia of the temporal region; the superficial vessels and nerves ramify in its substance. Passing beneath the integuments, it becomes lost in the dense compact tissue, separating them from the epicranial aponeurosis.

Aponeuroses. — These may be considered as three; the superficial, or common, the zygomatic, or temporal, and the temporo-maxillary.

Superficial aponeurosis. — Above the temporal fossa this aponeurosis is strong, thick, and inelastic. Its relations with the pericranium and integuments being similar to those of the frontal region, the same surgical considerations occur here as in that situation. Its dense unyielding texture, pressing upon collections of matter formed beneath it, causes denuding, or even necrosis, of the bone; and in inflammation of the subjacent cellular tissue, its resistance to the thickening and swelling accounts for the intense pain, and indicates the necessity of the various incisions, usually practised in these affections.

Over the temporal fossa it is thinner; beneath the zygomatic arch it becomes confounded with the superficial fascia, and passes into the parotid region. The branches of the superficial, temporal, and auricular arteries, &c. ramifying between its lamellæ inferiorly, and anteriorly, it is pierced by the superficial temporal branch of the fifth pair of nerves, and is generally united with the *zygomato-temporal* aponeurosis, although inferiorly it is separated from it by fat.

About an inch from the orbit, and above the zygoma, these two aponeuroses are fixed by a kind of pedicle, in which we find several small filaments of nerves, branches of arteries, and minute veins, proceeding from the temporal fossa.

Zygomato-temporal aponeurosis.—Of an oval form, and adherent to the whole of the curved line of the parietal bone, this aponeurosis gives attachment, on its internal surface, to the superior five sixths of the temporal muscle, being separated from it in the remaining sixth by fat. It here presents two laminæ, which become confounded with the periosteum covering the two surfaces of the zygomatic arch; the fat separating these two layers, when abundant, renders this point prominent, in the same degree as its absence produces a depression. Should suppuration occur between them, the pus must be evacuated early, otherwise the abscess will extend to the zygomatic fossa, the internal layer being much thinner than the external.

Temporo-maxillary aponeurosis.—Developed in the form of a fan between the fleshy fibres, of which it forms the tendon inferiorly, this latter aponeurosis will be described hereafter with the muscular apparatus. We shall only add, that the fat situated on the anterior border, becoming continuous with the cellular tissue of the jaw, not in the pterygo-maxillary fossa, as stated by M. Gerdy, but rather on the anterior portion of the zygomatic arch, may also become inflamed and suppurate, individually. Its softness, in some measure predisposes it, to collections of fluids, and the resistance with which it is surrounded, together with the action of the temporal muscles, almost inevitably forces the morbid fluids downwards, towards the jaw. It

therefore results, that abscesses of the temple may open into the mouth, in the same manner that abscesses of the jaw may point at the temple, and open near the external orbital angle.

Muscles. — The *frontal* muscle is sometimes prolonged into the superior portion of this region; the three *auricular* have been noticed, consequently it is only the *temporal* which remains. From the converging direction of its fibres, and their insertion on the central aponeurosis, embracing the coronoid process of the inferior maxilla, it is generally admitted, that they should be divided in the form of a V, in the operation of trephining. This advice cannot lead to danger; but the form of the division is of little consequence, as, whether the fibres are cut transversely, or nearly parallel, to the axis, the flap must be raised, and when once divided, we know that muscular fibre only unites by fibrous cicatrix.

Arteries. — The *superficial temporal* artery lies between the zygomato-temporal aponeurosis and the superficial fascia, so that, when divided, it is more easy to apply a ligature on the temporal than on the parietal portion of the region. Above the zygoma, it is situated about two or three lines anterior to the ear; it is, therefore, reached with facility in this situation, if it becomes necessary. This position should be borne in mind, as caustics, moxas, cupping glasses, and leeches should only be applied in cases of necessity, and then with the utmost caution. It may also be more prudent to open the temporal artery an inch or two nearer the forehead, inflammation occurring more easily, the cellular tissue being more abundant, the aponeurosis farther from the bone, and the compression attended with more pain inferiorly than superiorly and anteriorly; with these precautions the operation is easy and safe. The anterior branch of the superficial temporal artery anastomoses with the *frontal*, the posterior with the branches of the *occipital*. As these branches frequently unite among themselves, forming a complete network, covered by the skin and superficial fascia, it becomes necessary, when one is divided, to tie or compress both ends. Furnished by the preceding trunk in the centre of the zygomatic arch, the *middle temporal* immediately pierces the external layer of the zygomato-temporal aponeurosis, to ramify in the adipose tissue, separating this from the internal layer; afterwards traversing this latter, to end in the temporal muscle, by anastomosing with the *deep temporal*. These latter, proceeding from the internal maxillary, distribute their principal branches to the temporal muscle, and the external surface of its central aponeurosis; the others lie on the bone, in grooves peculiar to themselves. The anastomoses of the deep temporal with the branches proceeding from the orbit, account for the swelling which arises in the temporal fossa, in diseases of the eye, and vice versâ.

Veins. — There is at least one vein to each deep artery. The anterior branch of the temporal artery has not any when the

facial exists. We find, in this region, a very large emissary vein, emerging from the cranium through the parietal foramen; this will be noticed in speaking of the bones.

Lymphatics.—These commonly accompany the arteries; the superficial passing to the glands surrounding the ear, the others to the deep glands of the neck. Thus, swelling of the subcutaneous lymphatic glands indicates disease of the skin, or the parts external to the temporal aponeurosis, whilst disease of the deeper seated parts causes swelling of the intermuscular cervical glands.

The *Nerves* are very numerous, but unimportant, as regards operations in this region. They are divided into superficial and deep. The former proceed, first, from the *cervical plexus*, the branches of which ramify in the skin and subjacent cellular adipose tissue; secondly, from the *facial*, the numerous fibres of which accompany the arteries in the superficial fascia, anastomosing in the frontal region with the *supra-orbital;* thirdly, from the *auricular* branch of the *inferior maxillary*, which becoming the *superficial temporal*, and turning forwards, follows the same direction as the facial, with which it unites at every point. The latter are furnished, first, by the *temporal* branch of the *inferior maxillary*, and the *temporal* twigs of the *orbital* branch of the *superior maxillary;* secondly, in the parietal portion, by the anastomotic branches of the *frontal*, the *sub-occipital*, and *sub-mastoid*.

In diseases of the temple, these nerves cause acute pain in all parts of the head, extending to the orbit, jaws, face, ear, and neck reciprocally.

Bones.—The whole of the squamous portion of the *temporal* bone, the temporal portion of the greater wing of the *sphenoid*, a very small portion of the *frontal*, and the whole of the *parietal* are situated in this region.

The squamous bone is sometimes convex, sometimes smooth, or concave. The union between the *sphenoid*, *frontal*, *parietal*, and *temporal*, occurs at the deepest part of the temporal fossa; on this account, and from the middle meningeal artery being nearly always confined in a groove, sometimes converted into a canal, on the internal surface of the anterior inferior angle of the parietal bone, the operation for trephining has been forbidden. It is true that cases requiring perforation of the cranium here are very rare; it is also true that the operation is rendered difficult by the inequality of the surface, and the thickness of the soft parts. But if it is decidedly necessary, it should not be prevented by the situation of the artery, as this may easily be tied, compressed, or cauterized, if wounded.

The thinness of the bone accounts for the frequency of fractures here. The situation of the sutures should be studied, to prevent their being mistaken for fractures. It must also be remembered that the temporal is continuous with the zygomatic

fossa; thus polypi, &c., commencing on the antrum, may appear external to the organ. The *parietal prominence* is exceedingly variable, scarcely existing in some individuals, whilst in others it is well developed, and in many instances larger on one side than the other. This unequal conformation is remarked even in men of great talent; Bichat and Beclard, for instance. The bone is sometimes very thick at this point; thus militating against the idea that its prominence indicates a large developement of the cranium. The parietal bone frequently becomes as hard as ivory; its superficial situation favours the developement of the numerous diseases to which it is subject, whilst its convexity diminishes the liability of fractures; its greater thickness corresponds to its centre, subsequently to the posterior and superior angle, then to the posterior and inferior, and, lastly, to the superior and anterior. Near the posterior portion, between the parietal prominence and the sagittal suture, there are several foramina, communicating with the venous canals of the diploe, or, rather, of the cranium, and the sinuses of the dura mater, and giving passage to the emissary veins, already mentioned. It has, therefore, been considered that leeches, applied on points corresponding to these foramina, afford great relief in affections of the sinuses, meninges, or brain.

The *relative position* of the parts in this region is as follows:

1. Skin.
2. Cellulo-adipose tissue.
3. Superficial fascia, covering the superficial nerves and vessels.
4. Epicranial aponeurosis, separated from the latter by the nerves and vessels.
5. Zygomato-temporal aponeurosis and fat, dividing it, inferiorly, into two layers.
6. Temporal muscle, with the central aponeurosis and fat, which covers its anterior margin behind the cheek.
7. The pericranium.
8. The bones corresponding to the orbit, anteriorly, to the temporo-maxillary articulation posteriorly, and to the middle lobes of the brain, internally.

In addition to the sutures observed at the inferior portion of this region, the parietal sometimes presents another, which divides it, transversely, into two portions. The sagittal suture, also, may deviate so much as to be mistaken for fracture. The application of the trephine, upon the parietal bones, is more likely to be succeeded by hemorrhage than on the frontal, in consequence of the various depressions, for the lodgment of the branches of the meningeal arteries, visible upon their internal surfaces; and, as they are porous in the median line, their relation with the longitudinal sinus, and adherence to the dura mater, account for external swelling, caused by enormous developement of the Pacchionian glands.

SECTION THIRD.

OCCIPITO-MASTOID REGION.

The form of the occiput differs from that of the frontal. Its superior portion, slightly flattened, corresponds to the summit of the head, and supports the centre of divergence of the hair: the prominence occupying its centre indicating the point of union of the processes of the dura mater, whilst the interval, separating the cerebellum from the posterior lobes of the cerebrum, surmounts a fossa continuous with the nape of the neck, and bounded externally by the complexi muscles. The mastoid processes, placed laterally, pretty correctly denote the transverse dimensions of the cerebellum.

The *skin* covering the mastoid process, fine, smooth, and free from hair, presents the same characters as that investing the external ear; superiorly, it thickens considerably, and becomes very dense. The hair in this region remains the latest; it grows perpendicularly at the upper part, but more obliquely as it descends.

The *cellulo-adipose layer*, simply cellular behind the ear, is invested in the remainder of the region with small adipose follicles, similar to that in the forehead and temples. As this layer adheres intimately to the skin, wounds attended with loss of substance cannot be brought together, either by sutures or bandages. Its union with the subjacent layer explains why the integuments, extending from the forehead to the occiput, follow the motions of the frontal muscle.

The *aponeurosis* is strong, especially at the upper part, and in some individuals presents a very brilliant pearly appearance.

Muscles.—The *posterior auricular* attaches the concha to the mastoid process; the *occipito-frontalis* covers the two external thirds of this region, the remaining third, situated above the protuberance, being invested by its aponeurosis. These parts are separated from the pericranium by a layer of dense cellular tissue. The superior extremity of the *sterno-mastoid* and *splenii* muscles, although not specially belonging to this region, should nevertheless be noticed, as they may be wounded in operations performed upon it.

The *pericranium* presents nothing of interest, excepting its firm adherence to the bones.

Arteries.—The *occipital* and posterior *auris* are the only arteries of any importance. The former enters this region through the interval between the *splenii* and *trapezii muscles*; anastomosing with the posterior branch of the *temporal*, it is enveloped in the subcutaneous layer, and tied with difficulty. The latter lies in the mastoido-auricular depression, between the posterior auris muscle and the deep fibrous tissue. As it anastomoses with the preceding above the mastoid process, wounds in the two

superior thirds of this region, and opposite the mastoid process, are rarely succeeded by hemorrhage, unless they occur very close to the ear. We must also notice the small branch of the *occipital*, penetrating to the dura mater through the mastoid foramen.

Veins.—Each artery is accompanied by one, sometimes by two veins. There are also several emissary veins, emerging through the *lambdoidal*, *temporo-parietal*, and *temporo-occipital* sutures; and especially a large one which passes through the mastoid foramen. This latter frequently communicates with the veins of the diploe, and constantly with the lateral sinus. Hence the recommendation to apply cupping glasses and leeches on this spot, in order to relieve congestions of the brain, and of the ear in particular.

The *superficial lymphatics* pass to the glands behind the ear, the deep-seated to those beneath the sterno-mastoid muscle.

The *nerves* are derived from —

1. The posterior *auricular* branch, given off by the *facial*, as it emerges from the stylo-mastoid foramen, dividing like the artery of the same name.

2. The *sub-mastoid* branch of the *cervical plexus*, which, ramifying in the subcutaneous tissue, is distributed principally to the skin, and anastomoses with the anterior *auricular* branch of the same plexus, the branches of the *internal frontal*, and filaments of the *sub-occipital*.

3. Some filaments from the first *cervical*, and the posterior branch of the *sub-occipital*.

These latter nerves, distributed to the occipito-frontalis muscle, the aponeurosis, and pericranium, accompany the vessels, and anastomose with the preceding, but especially with the frontal. Their number, and the density of the cellular tissue through which they ramify, account for the pain and inconvenience attending inflammations of this portion of the head. Their frequent anastomoses are also a reason why neuralgia of the head, or face, is not always cured by the excision of the principal nerve.

The *great sympathetic* does not give off any distinct branch, all the filaments proceeding from it being distributed to the arteries.

The *bones* are, the *mastoid* portion of the *temporal*, the inferior angle of the *parietal*, and a portion of the *occipital*. The *Wormian* bones, situated in the lambdoidal suture, appear like a fracture, as may the anormal suture, which sometimes separates the occipital bone in the median line. The trephine should always be placed, in preference, on the centre of the lateral prominence of the occiput, the bone being there very thin, but thicker around. The presence of the occipito-parietal suture externally, of the longitudinal sinus in the centre, and of the lateral sinus inferiorly, are further reasons in favour of this prac-

tice; and we should not trephine over the posterior inferior angle of the parietal bone, because it is grooved, internally, by the lateral sinus. At the union of this angle with the other bones, the head of the fœtus presents a fontanelle, which sometimes remains during the early years of life.

The mastoid process, subject to numerous varieties, much less prominent in children than adults, and in women than men, is largest in old age. Its developement is almost always dependent upon the cells which it encloses. As these cells communicate, their perforation has been recommended and resorted to, in order to give exit to pus or blood contained within the ear, and also to allow air to enter the cavity of the tympanum. With regard to this operation, it must be observed, that it is not practicable in infants, as they have no mastoid cells; that the process in question is sometimes very thick, and, as it were, formed of two compact laminæ separated by diploe; that it is, under other circumstances, hard like ebony; and, finally, that its cellules have, in some instances, been found small, thickened, having no communication with the ear.

The mastoid portion of the occipital region is of great interest, in consequence of the numerous diseases which are developed in it. Nature herself sometimes causes perforation, to give issue to pus secreted in the ear. Caries and necrosis occur very frequently; and inflammations of the part are dangerous, on account of the structure and arrangement of the several tissues. It is frequently the seat of tumours, depending sometimes on swelling of the lymphatic glands, sometimes on morbid alterations of quite different characters.

Finally, it is here that moxas, blisters, &c. are applied, in the various affections of the head.

In proceeding from behind towards the bone, the relative position of the parts is as follows:—

1. Skin.
2. Cellulo-adipose tissue, containing the principal nerves and vessels.
3. The epicranial aponeurosis, and muscles.
4. The pericranium.
5. The bone.
6. The dura mater, with its folds and posterior sinuses.

SECTION FOURTH.

OF THE CRANIUM IN GENERAL.

There are some remarks applicable to nearly all the above-named regions, into the details of which we will now enter.

The hair, and numerous follicles surrounding its roots, appear to be the principal causes of the peculiar characters

marking the different species of eruptions. It is in consequence of the inelasticity of the scalp that tumours, forming between the aponeurosis and the integuments, are more or less flattened; that effusions of blood are rare; that these effusions, quickly reduced to their fibrous particles, are so often converted into indolent tumours; and that intense erysipelas ordinarily produces suppuration, in the form of small painful abscesses, independent of each other. The great thickness of the skin, and its intimate adherence to the subjacent tissues, cause the following peculiarities: when, after contusions, matter is thrown out, in a liquid state, a depression may be felt in the centre of the swelling, sometimes so well marked as to be mistaken for disease or fracture of the bone. The condensed texture of the parts, covering the bones of the cranium, is the cause of the erysipelatous character of the inflammations of this part. It is also the reason why ulcers are of a spreading nature, and cured with difficulty; why wounds with loss of substance are rarely, if ever, capable of immediate union; why, lastly, in suppurating wounds, the pericranium peels off so easily, causing a morbid secretion between the bones and their periosteum.

The arteries of the cranium, contained in the dense tissue uniting the aponeurosis to the integuments, are with difficulty secured by the ordinary instruments, but their proximity to the bone renders compression very easy. In consequence of their number and size, contusions of the cranium are usually followed by sanguineous collections, but the vitality with which the vessels endue the tissues, is, in its turn, the cause of their rapid absorption. In phlegmonous erysipelas, producing suppuration and mortification of the epicranial cellular tissue, their situation beneath the skin prevents the gangrene from attacking and destroying the integuments. This peculiarity, noticed long since by Dupuytren, requires that the surgeon should not spare incisions, if he would arrest the progress of disease. Hence also the flaps of the skin quickly unite after the application of the trephine.

Ecchymosis occurs, more frequently, over the forehead, temples, sides of the vertex, and neck, in consequence of the soft parts becoming relaxed as they descend.

The thinness of the bones at several points, the numerous vascular communications between the interior and exterior of the cranium, are reasons for the serious character of most of the external diseases of this cavity. On account of its spheroidal form, pus and other fluids always proceed towards its base. It is, therefore, on its circumference that incisions are to be made for the issue of these collections.

Surgeons have objected to trephine on various portions of the cranium, for the reasons which have been already mentioned; they also have objections to that operation being performed over the sutures, on account of the difficulty with which

the soft parts are separated from them, and of their intimate connexion with the dura mater. The size of the emissary veins which they enclose, their correspondence to the various sinuses, and the inequality of their dentations, with the presence of ossa wormiana, are also reasons for abstaining from that operation in these situations.

However rare these peculiarities may render such operations, they do not entirely obviate their performance when absolutely indicated; for instance, the adhesions of the dura mater to the sinuses prevent collections of fluids in their course; but, on the other hand, where effusion has taken place, the dura mater becoming separated, this objection no longer exists. In those cases where effusion occurs in the interior of the meninges, and on each side, there is no necessity to operate over the sutures. We should be led to consider, from their denticulations, that separation in the adult could not possibly occur, were it not for the cases published by MM. Robert, Goubert, and Lenvir, in addition to the two which I have myself witnessed. By abating the motion communicated to each bone, sutures diminish the frequency of fractures from jars and concussions, as these latter occur more easily in old age, in consequence of their gradual disappearance.

In childhood the bones of the cranium are so elastic, that they dent like a tin plate without being fractured. Accoucheurs are daily meeting with these cases. Separated by the diploe, either of its tables may be fractured, individually. The internal, being smallest and most brittle, is termed the *vitreous* table; it commonly breaks to a greater extent than the external. The veins ramifying on and through them account for the hemorrhage which sometimes succeeds operations. In fractures, the arteries grooving the internal surface frequently cause effusions of blood between the bones and the dura mater. Finally, the adhesion of this membrane prevents both effusions of blood and pus from extending downwards towards the spine, thus becoming one of the causes, why, under these circumstances, the operation for trephining is so advantageous. The false sutures and the vascular depressions on its external surface, sometimes lead to an erroneous idea of fracture. The disposition of the diploe in old people accounts for the atrophy, which occupies sometimes the whole, sometimes a portion, of the cranial cavity, and which, in all probability, is dependent upon gradual obliteration of the vessels.

Although the cranium encloses the most delicate organ of the whole economy, various portions of it may be removed, as by trephine or disease, without producing death.

Its softness, and the number of its vessels, cause the brain to participate in all the shocks received by the head; hence, the phenomena of concussions, effusions, &c. From the importance of its functions, all wounds of the head are dangerous; and the

distribution of its arterial ramifications leads to the idea, that effusions of blood are most likely to ensue in its gray substance. The fontanelles met with at the bottom of the temporo-parietal regions quickly disappear. Hernia cerebri may pass through them; and murderers have sometimes destroyed children, by puncturing the brain, at this situation, with needles and other instruments.

The anterior is the most regular and the largest; it is lozenge-shaped, and the four sutures extending to it cross it at right angles.

The posterior, often closed at birth, is the most important, with regard to parturition. It is distinguished by its narrow triangular form, and especially by the three sutures which converge towards it. The direction of these lines is, in reality, the only sign by which it may be recognized with precision, when the angle of the occipital bone is incompletely ossified, or when the sagittal suture is prolonged towards the spinal foramen, dividing this bone into two symmetrical portions.

From the arrangement of its various bones, the cranium is an oval or spheroidal shaped box, which resists shocks by means of its arches or spheres. The abundance of the veins ramifying through their substance, and the vascularity of their diploe, exposes them to hemorrhage, when perforated, to fungus hæmatoides, erectile tumours, fibrous degeneracies, to softening to such a degree as to bleed upon the slightest pressure, like flesh, and to acquire great thickness, such as an inch or more; in the latter cases, however, their spongy portion commonly disappears. The nature of the dura mater accounts for the tumours so frequently met with. The effusions between this membrane and the bone, being confined between two solid surfaces, easily change into fungoid tumours, which must be distinguished from the preceding.

In examining the cranium, then, layer by layer, we find —

1. Between the aponeurosis and the skin, a condense tissue, which in a great measure prevents collections being established in its substance; thus abscesses, and especially sanguineous deposits, in this situation, are commonly small, and predisposed to become transformed into tumours of various kinds, such as atheroma, steatoma, &c.

2. Between the aponeurosis and periosteum, a lamella, which, by its elasticity and porousness, favours in an especial manner effusions after inflammation; whence, the extensive mischief and suppuration in phlegmonous erysipelas, and other collections of blood, as the result of injuries.

3. Between the pericranium and the bones, cellular tissue, equally lamellous, but more dense, which acts in a similar manner, with regard to inflammation and suppuration, but remains sometimes fixed to the bones in separations of the parts, instead of adhering to and following the pericranium; consequently, col-

lections either of blood or pus may exist beneath the pericranium, without being in contact with the bones.

4. Between the dura mater and bones, a dense and filamentous tissue, tending to limit and press collections of any kind towards their point of exit, or towards the exterior, making the trephine an excellent remedy in these diseases.

5. Between the dura mater and the brain, the arachnoid cavity. This is rarely the seat of any other disease but inflammation, and diffused effusion, and, consequently, the trephine is of but little service in the treatment of its diseases.

It follows from these remarks, that collections either of blood or pus may occur in the head in six situations: under the skin; under the aponeurosis; under the pericranium; upon the dura mater; under the dura mater; in the substance of the brain.

We will terminate these remarks by observing, that the bones of the cranium, being developed by an eccentric movement, derived from its own proper vessels, instead of depending upon the periosteum, may lose the fibro-cellular layers covering their surfaces without necrosis necessarily following; that they may even then increase in thickness, and become covered with granulations, &c. either internally or externally.

CHAPTER THIRD.

OF THE FACE.

A SPECIES of pyramid, the apex of which is formed by the chin. The face is applied, as it were, in front of the first vertebræ, and appended to the anterior portion of the cranium, from which it is separated by a line drawn from the supra-orbital fissure to the mastoid process of the temporal bone. The numerous cavities it represents, and the important organs contained therein, require that it should be divided into the following regions: the *parotid*, *nasal*, *orbital*, *zygomato-maxillary*, *masseteric*, *genal*, *mental*, *labial*, *buccal*, and *pharyngeal*, and that these should be detailed, individually, before we proceed to a general examination.

SECTION FIRST.

NASAL REGION.

Two objects are to be considered in this region: the nose and the nares.

Nose.—Situated between the forehead, lips, orbit, and cheeks, *the nose*, the most prominent part of the face, is so placed that

its lobule is ordinarily directed towards the right side. On account of its prominence it is frequently injured, and its importance, as a feature, has led to the numerous varieties of rhinoplastic operations.

The *skin* is thick between the eyebrows and in the rest of this region; it is slightly elastic at the former point, where it is sometimes covered with hair. From its numerous sebaceous follicles, it is frequently covered with a greasy secretion, especially on the alæ. In some individuals this matter is easily squeezed out, in the form of small filaments. When thicker, it remains in the follicles, forming what are called maggots, which rarely attain any size.

The *cellular layer*, thin, dense, and compact over the body of the nose, contains no adipose vesicles, but on the root of this organ, where it is looser and thicker, a small quantity is met with; consequently, in the former situation, pathological productions remain small, flattened, and circumscribed, abscesses rarely occur, and inflammations are nearly always of the erysipelatous character; whilst, in the latter, the opposite phenomena take place. We may, moreover, remark, that the greater thickness of the various tissues in this situation is of utility in the formation of an artificial nose, at the expense of the frontal integuments. From the density and adherence of the skin to its subjacent membranes, simple wounds seldom gape, and are easily treated by the ordinary measures; whilst those which are accompanied by loss of substance cicatrise slowly, and by new formation.

The *muscles* are, superiorly and in the median line, the *pyramidalis nasi*, transversely and on its sides, the *compressor narium*, crossed by the internal portion of the *levator labii superioris alæque nasi*. The *depressor alæ nasi* also belongs here, but it may be as well to range it among those of the *labial region*. The three former appear to be blended in the nasal aponeurosis; but we should remember the direction of their fibres, that they be not divided unnecessarily, in the various operations performed upon this part.

The *arteries* are large and numerous, in comparison with the size of the organ. At its root is the nasal branch of the *ophthalmic*, anastomosing with the *facial*, whilst branches of this latter supply the sides, alæ and septum, branches from the *coronary* and *infra-orbital*, are also distributed to it; and, finally, the *ethmoidal*, running from the interior, ramifies in its lobule.

The *veins* empty themselves into the *angular*, which also receives the *frontal;* this arrangement accounts for the success which, according to the ancients, attended phlebotomy performed at this point, in certain diseases of the cranium and nasal prominence. Their abundant capillary branches being enclosed in the dense subcutaneous tissue, the circulation is not very free; a peculiarity which, perhaps, conduces, in a greater degree than

the arterial action, to the reddened state of this organ in some individuals.

The *lymphatics* accompany the arteries, and pass principally to the *submaxillary glands;* hence, swelling of these latter, in diseases of the nose.

The *nerves* proceed from the *ophthalmic* and *superior maxillary.* They are, superiorly, filaments of the internal and external nasal, furnished by the *frontal;* laterally, the numerous branches derived from the *infra-orbital;* anteriorly and inferiorly, the *ethmoido-nasal* branch of the *ophthalmic,* traversing the nares. The number sufficiently explains the extreme sensibility of this organ, and the pain and sympathetic disturbance produced by inflammation.*

Bones.—The relation between the nasal process and the lachrymal sac, its articulation with the *frontal* and *nasal* bones, the disposition of these latter relative to the cranium and nares, account for the cerebral disturbance, the diseases of the orbit, lachrymal sac, &c., sometimes produced by fractures, exostoses, and other affections of the nasal prominence. Thick and short, these bones can only be fractured by direct violence; thus the force capable of breaking them renders the injury serious, more from the mischief inflicted on the soft parts than from the fracture itself; and, moreover, being unsustained by the nasal fossæ, when once broken they are easily misplaced, and, unless the greatest precaution is observed, not only may great deformity ensue, but also interruption in the functions of respiration, speech, and smell. According to their degree of prominence, length, and thickness, is their liability to fracture, and upon this also depends the form of the nose.

The *triangular cartilages* encompassing the nares, and also forming the anterior portion of the septum, belong exclusively to the nose. That of the septum is so placed between the others, that, if necessary, a portion may be removed without penetrating the nasal fossæ. This may be effected by making an incision in the median line, when the cartilage is at once exposed, by separating the alæ.

The septum is also, occasionally, the seat of small abscesses, which point externally; these should be opened early, as they never burst on the interior of the nose. It is at the point where the latter unites with the lateral cartilages, that the most marked depression of the nose is situated. The *naso-lobular nerve* emerges between the inferior border of the nasal bone and the triangular cartilage; should this nerve become the seat of neuralgia, it is easily exposed and divided. All these cartilages are invested by dense perichondrium, uniting them to the sur-

* M. Velpeau has omitted the twigs derived from the malar branch of the temporo-facial division of the seventh, which, anastomosing freely with the maxillary branches of the cervico-facial, or descending portion of the seventh, supplies the muscles in this region.—H. H.

rounding parts, becoming continuous with the periosteum of the bones.

Syphilitic affections, cancer, and malignant ulcers sometimes render it necessary that the free extremity of the nose be amputated; this, as the above anatomical remarks have shown, may be done at the point of union between the bones and cartilages, and it was on this account that the rhinoplastic operation was first recommended.

The order of parts is as follows:

1. Skin.
2. Cellulo-adipose layer.
3. Muscles and aponeuroses; (the vessels and nerves ramify through the several laminæ.)
4. Periosteum and perichondrium.
5. Bones and cartilages.

In the lobule and alæ these various parts are so blended that it is almost impossible to divide them into separate layers. Possessing no skeleton, and being unsustained internally, this portion of the nose requires attention, in those wounds which penetrate completely through it, and its homogeneous structure renders the suture the most proper application.

As the lobule is strongly excavated at the side of the nares, loss of substance, however superficial, easily leads to its perforation, and then the continual passage of the air may convert it into a fistulous opening. So long as the bones remain healthy, the rhinoplastic operation can be performed, as the flap removed from the forehead is too vascular and elastic to cause any fear of mortification, and its structure renders union with the refreshened edges comparatively a certainty; but when the bones are destroyed, the rhinoplastic offers less advantage than the talliocotian operation, as, no longer having any support, the new parts separate from the old, and adhesion is thus destroyed.

SECTION SECOND.

NARES, OR OLFACTORY REGION.

Constituted by the nasal fossæ, the olfactory region is limited, superiorly, by the anterior third of the base of the *cranium;* inferiorly, by the vault of the *palate;* externally, by the *zygomatic* and *orbital* regions; posteriorly, by the *pharynx;* anteriorly, by the orifice of the *nose.* The septum dividing them often inclines more to one side than the other; a fault of symmetry which, carried to any extent, may interfere with the voice and respiration, and lead to the suspicion of the existence of morbid tumours. Acting upon this, some surgeons have destroyed the septum, mistaking it for these anormal growths. I saw, in 1824, in consultation with M. Bougon, two patients who had submitted to these experiments. The cartilaginous portion of the

septum touched the inferior spongy bone; and in one who had been operated upon three times, there had been so little care taken that the two nasal fossæ communicated by an opening, into which I could introduce the point of my little finger.

The anterior opening of the nares looks more or less directly downwards, according as the lobule is raised. Its form is triangular, with the apex forwards. The mucous membrane is thick, adherent, and light coloured, and participating in the characters of the skin. It supports the hair destined to prevent the admission of foreign substances. Its skeleton is formed by the double cartilage already described in the nasal region. Enclosed between the skin and mucous membrane, this cartilage does not adhere to the anterior nasal spine, but, on the contrary, its internal portion arching outwards, in the form of a circle, towards its external division, which, on its part, inclines inwards, directs the base of the anterior opening towards the upper lip, making this opening inferior to the plane of the nasal fossæ; so that, to introduce a sound, forceps, a finger, or any foreign body into the nares, the instrument must at first be passed obliquely upwards for some lines, before it is inclined horizontally; and to examine these cavities, it is necessary that the lobule be raised to some extent.

The *vault* or *roof*, the longest wall of the nares, is divided into three portions.

The *first* or *anterior*, inclined downwards in the direction of the nose, to the back of which it corresponds, forms, by uniting with the septum, a deep fossa, where the *mucous membrane* is fixed and villous, without presenting any follicles. Polypi and cancerous ulcers, termed ozæna, are frequently observed in this situation. Its *skeleton* is formed by a small portion of the nasal fissure of the frontal bone; by the posterior surface of the *nasal* bones, directed outwards towards the ascending process of the superior *maxillary* bones; by the internal surface of the *triangular cartilage*, and of that of the free extremity of the nose. Terminating beneath the latter, the nasal fossa forms a kind of cul-de-sac, rendering the lobule much thinner than at first sight it appears to be. Thus, in removing cancers, we should be careful not to excise deeper than is necessary, lest we make a communication between the exterior and interior.

The *ethmoidal vessels* and *nerves* lie between the mucous membrane and the alæ, and a large arterial and venous branch ramifies over the lobule and back of the nose. The activity of the arterial circulation, explains the discoloration which occasionally manifests itself, in these parts, during some diseases, indicating, in general, epistaxis.

The *naso-lobular* nerve is inclosed in a groove, which conducts it towards the inferior margin of the bone, where a small fissure allows it to pass to the external surface of the cartilages.

The *middle portion* is horizontal, and corresponds to the eth-

moidal fossa of the cranium. It is only two or three lines in extent; its mucous membrane is thick, soft, and villous. The cribriform plate of the ethmoid, and, posteriorly, a small portion of the wings of Ingrassias, form its skeleton. From this reason projectiles, or foreign substances of any kind, thrust with any violence, may enter the cranium, causing immediate death from laceration of the brain; but, under all circumstances, wounds of this part are exceedingly dangerous, for, even if they do not prove fatal, they may at least produce loss of smell, by destroying the olfactory nerve.

The frequency of diseases, the thinness of the bones, the common occurrence of caries in inveterate syphilis, and the anatomical relation of this region with the cranium, account for the presence of hernia cerebri in the nose, as mentioned by Boyer, and of the fungoid tumours of the dura mater, which I have witnessed; an accident which the primitive absence of the cribriform plate of the ethmoid bone, as observed by Blandin, would render still more likely. It is at the spot where this portion of the vault unites with the preceding, that we find, on the sides of the cresta galli, the small fissure for the passage of the *ethmoidal* branches of the *ophthalmic artery* and *nerve*, from the cranium to the nose.

The *third portion* inclines downwards and backwards, corresponding to the sella turcica. Its mucous membrane, which is rather more compact, presents follicles, and is continuous with that lining the vault of the pharynx. Its skeleton, formed by a prolongation of the orbitar process of the palate bone, a plate of the vomer, which, with the body of the sphenoid bone, constitutes a small canal through which run the *pterygo-palatine nerve* and *artery*, is completed, anteriorly, by the body of the sphenoid and its turbinated bones. We here find an irregular opening of variable dimensions, leading to the sphenoidal sinuses. Some surgeons consider that the bad odour emitted by individuals, depends upon ulceration of the membrane lining these cavities, which increase in advanced age.

The *internal wall* of the nares, formed by the surfaces of the septum, presents a thick vascular pituitary membrane, lying on a fibrous lamella, which exists through the whole extent of the nasal fossæ. Fibrous polypi appear to arise especially from this membrane, whilst the soft fleshy polypi, according to Dzondi, have their origin in the villous layer. In addition to the internal nerves of the vault, the *naso-palatine* is also met with here. The osseous portion of this wall is formed by the whole of the *vomer;* anteriorly and superiorly, by the perpendicular plate of the *ethmoid;* afterwards, directly forwards, by the cartilage of the septum. We must likewise add the azygos process of the *sphenoid*, which is received into the vomer, the nasal spine of the *frontal*, applied upon the plate of the *ethmoid*, and, inferiorly, a species of crest, formed by the union of the *maxillary* and *palatine*

bones. As all these parts are thin and easily broken, pressure caused by polypi may produce perforation, which in some cases is congenital.

Formed by the superior surface of the palatine roof, the *inferior wall* or *plane* of the nasal fossæ is about two inches long. Concave and regular transversely, level from before backwards, slightly inclined towards the pharynx, it presents an elevated anterior border. The *schneiderian membrane* possesses the same characters as on the septum, but it receives fewer nerves, and is rarely the seat of polypi; syphilitic and cancerous ulcers, on the contrary, are frequent. The palatine process of the *maxilla*, and the horizontal portion of the *palate*, form its skeleton; there is, consequently, a transverse suture uniting these bones, and, occasionally, a second placed more anteriorly. It is the separation of this latter anormal suture which so frequently co-exists with simple or double hare-lip. Between it and the septum, close to the anterior border, is situated the nasal opening of the anterior palatine canal, enclosing the *naso-palatine nerve* and *ganglion*. This orifice, hidden by the mucous membrane, can only be seen in the dried bones.

The *external wall*, larger than the preceding at its lower and middle portions, is shorter superiorly; the *mucous* membrane is thicker, redder, and more vascular here than elsewhere, but it becomes thinner on entering the accessory cavities. It forms a fold on the free margin of each turbinated bone, increasing their size, and prolonging them from before backwards; its adherence to the skeleton is very firm, and as it incloses several vessels, it requires but slight congestion to produce epistaxis. The numerous reflections which it makes in investing the crooked surfaces of this region, are probably the principal causes of the congestions, tumours, and diseases of various kinds so frequently met with. We must be on our guard against mistaking the swollen folds, which form the margin of the turbinated bones, for polypi, as they have, in consequence, often been torn away and injured.

Superiorly, and a little posteriorly, is a superficial fissure, separated from the vault by a small crest, into which enters that which Gavard called the square lamella (lame carrée) of the ethmoid, but which conducts to no cavity of importance. More inferiorly is the *superior turbinated* bone, terminating in the centre of the wall; the fossa circumscribed by this bone is larger and more superficial posteriorly than anteriorly; in the former direction it leads to two openings.

The *superior* communicates with the posterior *ethmoidal cells* and the *sphenoidal sinus;* it may be reached by passing a probe above the middle turbinated bone along the external wall of the superior meatus, and by slightly raising the extremity of the instrument as we arrive near the end of this fossa.

The *inferior*, situated on the internal wall, and leading directly

into the *pterygo-maxillary* and *zygomatic* fossæ, is only visible in the dry bone. The spheno-palatine nerves and vessels enter the nose through this opening; polypi also may traverse it, passing from the nasal to the zygomatic fossa, and thence into the substance of the cheek, anterior to the masseter muscle. Anteriorly, this meatus terminates by a plain surface, presenting nothing remarkable. Beneath the superior meatus is situated the *middle* or *ethmoidal turbinated bone*, extending as far as the pharyngeal opening of the nares. The anterior extremity of this bone is slightly raised, and ends about four or five lines from the nasal bone; thus, it is more projecting, and the middle meatus deeper in its centre than at its two extremities, is much more everted anteriorly than posteriorly. We also meet with two openings here.

The *superior*, situated beneath the anterior extremity of the spongy bone. A small depression proceeds hence, from behind forwards, upwards and outwards, penetrating into the frontal sinus. On account of this opening, wounds of the sinus with loss of substance generally remain fistulous, and the different morbid productions formed in the nose may enter into the frontal cavity, and polypi, pus, &c. reciprocally descend from the sinus into the nasal fossa. In cases of necessity, injections may be passed through this opening.

The *inferior*, situated towards the middle meatus, a little above the lower edge of the spongy bone, at about an inch and a half from the anterior nasal opening, is excavated. To penetrate here, the instrument should be introduced from below, upwards and outwards. Its mucous membrane is thick, and forms a circular fold, containing numerous large follicles, considered by some anatomists as glands. This fold, like those on the free border of the spongy bones, is liable to swell, and thus close the antrum of Highmor; but it does not form a valve, neither does it enclose ary sphincter muscle of the part.

The *antrum of Highmor*, or the maxillary sinus, is pyramidal in shape, and a very important part of the face. Corresponding to the floor of the orbit, its *superior wall* encloses the *infra-orbital nerves* and *vessels*, also the *anterior superior dental nerve*. This, in some degree, explains the affections of the eye, occasionally attending extraction of a canine tooth.

Its *inferior wall*, lying on the alveoli, is frequently pierced by the roots of the teeth, the third or fourth molar being the most projecting. Hence, the custom of selecting their cells for its perforation. The relation of the large teeth with the antrum, moreover, accounts for the fistulæ and other accidents which succeed their extraction in some individuals.

Its *posterior wall*, round and concave, incloses the *posterior dental* nerves, and corresponds to the zygomatic fossa.

Its *apex* is prolonged into the malar eminence, and is sometimes so close to the surface that surgeons have selected it as

the most convenient point for perforating the antrum. Its largest wall is at its base; corresponding in its whole extent to the middle meatus of the nasal fossæ, it opens into its centre, nearer the superior than inferior portion. Thus, pus and other matter may escape more easily from the maxillary sinus, by an artificial opening in the alveoli, than by its natural orifice.

After the middle meatus comes the *maxillary or inferior turbinated bone*, the longest and largest of all, terminating by an elongated point near the pharyngeal opening, and inclining downwards towards the facial opening of the nares. Its free border, separated sometimes three, four, or five lines from the floor and external wall of the nasal fossæ, is, on the contrary, in other cases, so much constricted, that the inferior meatus is converted into a complete canal; hence, the various results obtained by different surgeons in their endeavours to penetrate into the nasal canal after the manner of La Forest. It may be useful to dilate a little upon the anatomical relations of the inferior meatus. Corresponding, externally, and from behind forwards, to the vertical portion of the palate bone, to the internal surface of the nasal portion of the superior maxilla, or to its sinus, finally to the inferior curve of its ascending portion, this meatus is principally formed by the concave surface of the inferior spongy bone, and, inferiorly, by the external portion of the floor of the nasal fossæ.

The *nasal canal* opens at the union of the internal and external walls of the inferior meatus, but in such a manner that it is prolonged a line and a half, or more, on the latter. Formed at the expense of the inferior spongy bone, the orifice of this canal looks inwards and backwards. Thus, in operations for fistula lachrymalis, the canula should be introduced in this direction, and probes should be passed from behind forwards and outwards. It is situated about six lines from the orifice of the nose, and is limited, anteriorly, by a slight projection of the posterior border of the ascending process. Superiorly, beneath the turbinated bone, this prominence is separated from it by a species of cul-de-sac, in which the probe is sometimes engaged. My own experience leads me to consider that this is a difficulty of frequent occurrence. Another cause of embarrassment arises from the instrument not being sufficiently curved, when, abutting against the posterior wall of the canal, it penetrates at the slightest effort into the maxillary sinus; the reason of this being the direction of the canal, which is obliquely upwards and forwards, or slightly outwards; and especially the fold or valve, which, contracting the opening, directs it nearer to the posterior than the anterior portion of the bony canal.*

* A probe may also be introduced into the nasal canal through the punctum lachrymale. The following is the best method. The surgeon, standing before the patient, should draw the lower lid downwards and outwards, thus everting the tarsal margin; the punctum will then be seen at about two lines from the internal angle

It is also by the inferior meatus that a probe may be passed from the nose into the pharynx and eustachian tube. If it is raised too much it will break the spongy bone; but this inconvenience may be avoided in the ligature of polypi, or in plugging the nasal fossæ, by carrying the instruments on the inferior wall of the nares, or between the vault and the superior spongy bone, instead of introducing them through the middle meatus.

The *bones of the external wall* of the nasal cavity are only remarkable according to their degree of fragility. Posteriorly, its skeleton, formed by the pterygoid process, and the posterior portion of the superior maxillary, to which is attached the vertical plate of the palate bone, is sufficiently firm. In its middle division it is extremely brittle, being only composed of the thin lamellæ of the ethmoid and the internal wall of the nasal sinus. Thus, operations performed at this point almost always destroy its bony layers. Anteriorly, it is very solid, being wholly constituted by the nasal process of the maxillary. Although the fragility of the bones here is prejudicial in so many cases, it is, nevertheless, of utility in others. For example, it was the slight resistance of the lachrymal bone, which suggested the operation for the formation of an artificial course for the tears, either according to the process of Wolhouse, or to those of Hunter, Scarpa, &c.; the aim of all these operations being to make a communication between the nasal canal and the middle meatus.

The *posterior opening* of the nasal fossæ is double, like the anterior, and formed by the termination of their four walls, elongated vertically; it is rather larger inferiorly than superiorly; its vertical diameter is about an inch, but it is only six lines transversely. Thus, in introducing the finger, plugs, &c. from the pharynx into the nose, we should place the greater diameter in the vertical direction.

The *arteries* proceed from the *internal maxillary* through the pterigo-palatine foramen, from the *ophthalmic* by the ethmoidal branches, and from the *facial* by the coronary. They are much too small to require any enlarged remarks, unless it be, that, in ramifying in the mucous membrane, they are very superficial, and predisposed to hemorrhage.

A *collateral vein* accompanies each artery; but there are some communicating through the foramen cœcum with the extremity

of the eye, projecting like a papilla. Through this a probe is introduced, at first vertically downwards, for about a line, when the hand should be depressed, so as to bring the instrument on a level with the external angle. After this it is carried for about four lines directly from without inwards, towards the nose, when its course will be arrested by the lachrymal bone. If the instrument is now raised to a right angle, having its extremities directly upwards and downwards, the slightest pressure will force it across the lachrymal sac into the nasal duct.

Throughout the operation the lower lid should be stretched downwards and outwards, otherwise the point of the probe is liable to catch in folds of the lining membrane.—H. H.

of the longitudinal sinus, and others passing into the coronary sinus through the foramina of the sphenoid bone. Vicq. d'Azyr considered that this arrangement gave rise to the hemorrhage occurring from the nose in cerebral affections. These veins unite the circulation of the nose with that of the brain.

Lymphatics.—As yet but little understood; these pass into the sub-maxillary and parotid glands.

The *nerves* are furnished by the *first* pair, which is entirely confined to this region, and by the *fifth*, which supplies numerous branches coming from the *ophthalmic* and from the *spheno-palatine ganglion*. From recent experiments, the branches of the former appear to be specially endowed with the sense of smell, and those of the latter with general sensibility. In addition to these, the nares receive some branches of the *great sympathetic*.

The participation of the nasal fossæ in the congestions and inflammations of the brain is fully explained by their emissary vessels, and the common origin of their arteries. When leeches applied to the interior of the nose produce happy results in these diseases, and in certain fevers, it is also to be attributed to the same communication, and to the continuity of the pituitary with the mucous membrane, of the gastro-pulmonic organs. Hence also arises the danger of epistaxis to any great extent. Bleeding or sarcomatous polypi arise, more particularly, from the body of the sphenoid bone, because the vessels of its spongy tissue, joined to those of the fibro-mucous membrane of the nose, form a more abundant plexus here than elsewhere. The purely fibrous tumours are removed with more difficulty, since they not only arise in the deep layer of the schneiderian membrane, but are also continuous with the bone itself.

The various situations of polypi, following the direction offering least resistance to their developement, depend on the arrangement of the osseous system. The narrowness of the vault limits their progress superiorly; the resistance of the pterigoid process, posteriorly, and of the nasal process, anteriorly, being nearly equal, they would scarcely emerge with greater facility on one side than on the other, were it not for the elastic cartilages of the nose, which are absent in the pharyngeal opening. Meeting with less obstruction in the ethmoid bone, the septum, the nasal wall of the antrum of Highmor, and also in the cribriform plate, their middle portion increases mostly by sending prolongations into the maxillary, frontal, and sphenoidal sinuses, at the same time that they emerge through the natural opening anteriorly and posteriorly.

It is thus that a polypus may deform the orbit, and thrust the eye towards the face; depress the roof of the palate, contracting the mouth; invade the nares, surrounding sinuses, and meatuses, ere it protrude through the cheek; enlarge the pharynx, by depressing the velum palati, preventing deglutition; press on

the Eustachian tube, producing deafness; push up the base of the cranium, penetrating the ethmoidal cells, or even the cranial fossæ; and, finally, escape through all the orifices of the olfactory cavities, forming tumours externally in their neighbourhood.

The continuation of the inferior meatus with the lachrymal sac shows how affections of the nasal fossæ may react on the conjunctiva, contract, and finally close the nasal canal. The septum being stronger than the cribriform plate of the ethmoid, explains why it is less frequently fractured than the latter. The ascending processes account for the disturbances and concussion of the brain, and fractures of the cranium, from violent blows struck from below upwards, on the chin, or superior maxillary bone. Finally, the aptitude of the mucous membrane to imbibe all kinds of fluids, and the impossibility of its swelling on any but its free surface, render it the cause of difficulty of respiration, by the constriction of the nares, in congestions arising from colds, &c.

The number of the turbinated bones is sometimes four, or even five, and thus may give rise to the embarrassment experienced by some surgeons in passing sounds into the nasal fossæ.

SECTION THIRD.

ORBITAL REGION.

Comprehending the whole apparatus of vision, and the lachrymal organs, having internally the nasal, externally the temporal, superiorly the frontal, and inferiorly the zygomato-maxillary regions, the orbital presents to our consideration the orbital arches, eyelids, palpebral angles, eye, and orbit.

Superciliary arch.—The *skin* entering into its composition is thicker than that of the eyelids, thinner than that of the forehead, elastic, and gives insertion to the eyebrows, which, generally of a deeper colour than the hair, are destined to diminish the intensity of light. Thus, their destruction is frequently attended by ophthalmia and other diseases of the eye. The size of the eyebrow depends on several causes; on the quantity of its hair, on the thickness of the soft parts upon which they repose, and, especially, on the degree of prominence of the bony arch.

The *subcutaneous cellular tissue*, forming a dense, thick, filamentous layer, in which we meet with adipose cells, offers nearly the same characters in the eyebrow as in the scalp generally, and is, consequently, subject to the same surgical consideration.

Muscles.—The superior fibres of the orbicularis palpebrarum follow the same direction as the arch. The inferior portion of the occipito-frontalis descends perpendicularly, behind the preceding; internally is a portion of the pyramidalis nasi, and close to the bone the corrugator supercilii. This latter, the most important of all, passes obliquely upwards and outwards, between the frontal and the naso-palpebral, terminating in the skin. As the cellular tissue separating them is loose and lamellous, pus is frequently infiltrated at the side of the eyelids after wounds; consequently, these should not be immediately brought together, if suppuration be expected, and in the event of its occurring, it must be evacuated at a very early period. If the division be horizontal, its inferior lip, drawn by the palpebral muscle, descends below the orbital arch, whilst the other separates from it, being drawn up by the occipito-frontalis. It is this which renders the application of bandages on the forehead so favourable; the best way to prevent the numerous inconveniences which result in these cases being, to push the eyebrow from below upwards, with graduated compresses, and keep it in this position by bandages properly applied.*

The *arteries* are not proper to this part; in fact, most of them merely traverse it. They are, externally, some branches of the anterior *temporal;* internally, of the *nasal* and *supra-orbital*, the trunk of which ascends between the frontal muscles and the eyebrow. Consequently, a wound occurring about an inch superiorly, and external to the tendon of the orbicularis, may cause considerable hemorrhage; in which case, if the division of the artery has taken place between the muscles, a ligature may be easily applied, on account of the loose texture of the cellular tissue. Above the eyebrow, on the contrary, compression is most easy, as the vessel is with difficulty secured in the subcutaneous layer.

The *superficial veins* present nothing of peculiarity; the others follow the direction of the arteries. The frontal, which receives nearly the whole of the former, descends on each side of the nose, where it assumes the name of angular.

Lymphatics.—Some accompany the blood vessels of the face, and pass to the sub-maxillary glands, whilst those of the external portion are directed towards the anterior of the ear; thus diseases of the head and eyebrow cause swelling of the submaxillary gland, whilst those of the parotid region are affected in the diseases of the external half of the superciliary arch.

Nerves.—Besides the filaments of the *facial* anastomosing with

* This is by no means sufficient to prevent subsequent disfigurement, as the best applied bandage cannot counteract the action of the muscles, and thus, in spite of the greatest care and attention, the edges of the wound will be drawn from their apposition, and a much larger scar, and consequently greater disfigurement, will occur than if the wound be first drawn together by sutures, and then a bandage applied as above. As a general rule, also, it must be observed, that all wounds of the face should be united by suture.—H. H.

the *supra-orbital*, and some branches of the *internal nasal*, anastomosing with the *frontal*, we find here the two portions of the *supra-orbital* sometimes emerging from the orbit together, through the foramen of the same name; but the smaller portion passes; more frequently, between the pulley of the superior oblique and the internal orbital process. As this nerve appears to be the seat of neuralgia of the forehead, its division has been recommended. It may be exposed immediately at its exit from the notch, as, in this situation, we have only the skin, the naso-palpebral muscle, and two layers of cellular tissue to divide, and the nerve is easily found, by passing the tip of the finger along the bony arch, when the first depression met with is that containing it. It is, generally, situated an inch external and superior to the tendon of the orbicular. In this operation, we should be careful not to raise the eyebrow too violently, as the spasm of its muscle thus produced will draw it down, and interfere with our further progress.

The *skeleton* belongs entirely to the frontal bone. Its external half is generally prominent, and thin, frequently dividing the integuments in falls or blows on this region. The internal is rounder, supporting the head of the eyebrow, and is more or less prominent, according to the extent of the corresponding frontal sinus.

The orbital arch is much less frequently fractured by blows upon it, than is the roof of the orbit, which is much thinner.

Eyelids.—Continuous, superiorly, with the eyebrow, the upper is longer, larger, and more curved than the inferior.

The aponeurotic expansion of the elevator muscle, the tarsal cartilage, meibomian glands, and conjunctiva, enter as elements into this eyelid, the free border of which presents, firstly, the ciliæ anteriorly; secondly, the orifices of the mucous follicles, posteriorly; thirdly, the punctum lachrymale, situated at the union of its four external with its internal fifth; fourthly, the opening of the ducts of the lachrymal gland, between the conjunctiva and the internal surface of the tarsal cartilage.

The inferior, extending less, transversely and from below upwards, than the preceding, is continuous with the inferior orbital ridge. Its constituent portions are like those of the superior, the skin equally fine, cellular tissue, in which a small quantity of adipose vesicles are sometimes developed, the inferior portion of the palpebral ligament, the tarsal cartilage, a fine cellular tissue, and the conjunctiva, but rarely a depressor muscle.* Its free border, less concave than that of the upper lid, differs from it in no other respect. Each of these elements is remarkable for some peculiarity.

The *skin*, extremely thin, soft, and vascular, becomes quickly blue or livid in some indispositions. It is never covered with

* Some fibres of the orbicularis palpebrarum also enter into its formation.—H. H.

hair. Transversely wrinkled in old age, it is always very loosely attached to the subjacent cellular tissue. It is by virtue of its elasticity, that the skin of the eyelids becomes sometimes so elongated as to allow of entropium, producing ophthalmia, which can only be cured by the excision of a portion of this relaxed integument.

As the *cellular tissue* never encloses fat, the eyelids, in corpulent individuals, appear sunken. Its looseness allows, on the other hand, of infiltrations, which are of frequent occurrence, and accounts for the ecchymosis after the application of leeches. The cellular tissue, uniting the muscle to the ligament of the eyelids, and to the tarsal cartilage, although lamellous, is nevertheless denser, and does not allow of infiltration with the same facility. Small encisted tumours are developed between its lamellæ; these should be removed through the internal surface of the eyelid.

Muscles.—In the inferior lid we only find a portion of the orbicular, whilst the superior incloses a muscle proper to itself, whence the great mobility of the latter, compared with the former. The fibres of the common orbicular muscle are paler, less curved, and form a thinner layer, as they approach its free border; their insertion shall be examined in treating of the great angle.

The *palpebral ligament* is attached to the external half of the two orbital ridges. Situated between the orbicular muscle and the conjunctiva, it appears to be continuous with the external extremity of the tarsal cartilages. Inflammations are very painful, external to the orbit, in consequence of the resistance it opposes to the swelling of the part; and, for the same reason, it for a long time prevents tumours formed between it and the conjunctiva, or in the orbit, from projecting outwards.

The *tarsal cartilages* are much thinner at their convex margin than towards the palpebral opening; in the former direction they unite with the ligaments, and also with the proper elevator muscle of the upper lid. In the latter, they are only enveloped by skin and mucous membrane, to which they are firmly attached. This accounts for the pain which accompanies inflammation of this part. Covered by the orbicular muscle, they lie on the conjunctiva, from which they are separated by the meibomian glands. The cartilage of the upper lid, in relation with the ducts of the lachrymal gland, extends for five lines from above downwards, and from five to six transversely. The other is equally six lines transversely, but from above downwards it is only about two in extent. Their posterior surface is concave, and moulded to the convexity of the eye; in fact, properly speaking, these cartilages form the skeleton of the eyelids.

The *conjunctiva*, dense, and united in a firm manner to the internal surface of the free border of the eyelids, becomes gradually soft, and elastic, as it approaches its point of reflection

over the eyeball; thus, when we would excise a portion as a remedy for ectropium, it is better to cut, as far as possible, from this border. It is for the same reason, that leeches applied too near the ciliæ cause much pain, and bleed but little, whilst applied further off, they produce but little suffering, bite, and fill quickly, and have considerable effect. The increasing softness and vascularity of the conjunctiva, as it approaches the eyeball, and the corresponding abundance and elasticity of the cellular tissue, explain why its acute swelling so promptly produces ectropium, whilst its simple chronic inflammation leads to nothing of the kind.

The *small glands*, known as *palpebral follicles*, or meibomian glands, arranged in parallel lines, in the fissures presented by the ocular surface of the tarsal cartilage, all open on the posterior crest of the free border of the eyelids; the conjunctiva is prolonged into their orifices. In ophthalmia, dependant upon their affection, the various ointments recommended for their cure should be applied, posteriorly, along the whole of the edge of the eyelids, and not simply in one of the angles.

The *arteries* are, internally, the two *internal palpebral* branches of the *ophthalmic;* externally, the two *external palpebral* branches of the *lachrymal;* superiorly, some twigs of the *supra-orbital;* and, inferiorly, some branches of the *infra-orbital* and the *facial.* The four first form two arches of the same direction, and are situated at four or five lines from the free margin of the eyelids, behind the naso-palpebral muscle; as they exactly correspond to the coronary arteries of the lip, they should be noticed with regard to their position, and size, in operations. For example, it should be remembered, that a sufficiently large half circle may be removed from the ciliary border, in cancerous or other affections, without their being wounded; whilst, if we are obliged to remove the tumour together with a portion of the sound parts, in the form of a V, these arteries are necessarily divided.

The *veins*, in general, empty themselves into the *ophthalmic*, but some few pass into the *angular*. Larger than the arteries, and communicating directly with those of the brain, they, to a certain degree, explain the pain, redness, and pathological condition of the eyes in affections of the head.

The *lymphatics* of the external portion of the superior eyelid alone, run to the parotid region; all the others traverse the face, and terminate beneath the jaw.

Nerves.—Internally, parallel to the arteries, are the *palpebral* filaments of the *nasal;* externally, the branches of the *lachrymal* and *facial;* superiorly, the two branches of the *frontal* are met with; and the inferior lid receives the *infra-orbital.* It is to this great supply of nerves that the eyelids owe their exquisite sensibility, augmented, towards their free edge, by the peculiarity of their texture.

The ciliæ form a curve, the concavity of which is directed towards the orbital arches. Arranged in two or three lines, they may deviate so as to be inclined towards the eye, instead of taking a contrary direction. Their roots, surrounded by follicles, the diseases of which often cause their destruction, present bulbs, which receive numerous nervous filaments, furnished by the palpebral, and, in general, easily traced into the bulb of the hair.

The *eyelids* lead to numerous surgical considerations. The protection which they furnish to the eye is so essential, that their destruction is constantly followed by incurable ophthalmia, and disorganization of the cornea. The ciliæ themselves are also sufficiently important for their loss to give rise to continued inflammation of the conjunctiva; so that, for this reason alone, common sense would reject all those methods which, in ectropium or entropium, consist in the removal of the palpebral margin. The transverse folds of the superior lid depend upon the direction of the levator muscle, and its insertion at the bottom of the orbit; these folds require that incisions should always be made in that direction, unless there be special reason to the contrary. It is also the paralysis of this muscle that causes the lid to fall in ptosis. Being nearer the skin than the conjunctiva, the orbicular muscle, contracting spasmodically, produces entropium: which Key attempted to cure, by excision of a portion of its fibres; but which Jacob treated more efficaciously, by incision at the palpebral angle.*

From the softness of the integuments, all cicatrices in the immediate neighbourhood of the orbit tend to evert the tarsal cartilages, in the same manner that congestion, infiltration, or relaxation of the skin or subcutaneous tissue, prolonged for any period, produces inversion. Hence the necessity, in the former case, either to excise a portion of the conjunctiva, or to elongate the external layer of the lid, by the blepharo-plastic operation, or to remove a triangle from the whole substance of the organ; thus obliging it, in cicatrising, to reassume its proper position. The lamellous condition and elasticity of all the tissues cause inflammations external to the ciliæ to assume, generally, an erysipelatous character. The compact texture of the free border of the lid produces quite a contrary effect; and the follicles,

* Mr. Guthrie's method of operating in entropium, which I have often seen adopted with success, at the Royal Westminster Ophthalmic Hospital and elsewhere, is as follows:—He removes a transverse fold of the relaxed integument, of the required extent, and afterwards divides the tarsal cartilages, vertically, at about a line from the external angle, and near the internal angle, just external to the punctum; ligatures are then passed through the two edges of the transverse wound, bringing them together, and thus everting the lid, which is drawn either upwards or downwards, as the case may be, by the extremities of the sutures being fixed by sticking plaster to the forehead in the upper lid, and cheek in the lower. In entropium of the lower lid, he commonly divides the cartilage only at the external angle.—H. H. *See* Guthrie on the Operative Surgery of the Eye.

glands, and bulbs of the hair here situated sufficiently account for the various forms of diseases common to it. Being large, and elevated at its root, the superior eyelid is easily everted; thus its conjunctiva, which is often covered by granulations, is frequently attacked by chronic inflammation, lasting for months, and even years.

The temporal angle of the lids consists of a deep depression, limited, superiorly, by the external orbital process, and, inferiorly, by the frontal angle of the malar bone. As the palpebral commissure is generally two or three lines within the bone, the eye appears, accordingly, either larger or smaller. The free borders of the lids, uniting towards their extremities, even when they are half open, easily contract anormal adhesions, if care be not taken to separate them frequently, when they are the seat of excoriation or inflammation.

We find in this angle—

1. The skin and cellular tissue, common to the lids.
2. The external extremity of the fibres of the orbicular, and the raphé, resulting from their interlacing.
3. The strongest portion of the palpebral ligaments.
4. The conjunctiva.
5. The origin of the two external palpebral arteries.
6. The termination of the lachrymal nerve.
7. Some filaments of the facial.
8. Finally, the zygomato-frontal suture.

In some individuals, especially in old persons, the skin of this angle presents numerous convergent folds. Notwithstanding these, which are vulgarly named crow's feet, incisions may be made in any direction, as the muscle here has no fixed point of attachment, and there are no nerves or vessels of any importance; however, as the conjunctiva lies at some distance from the palpebral ligaments, penetrating wounds of this part are dangerous, from the facility with which inflammation and pus extend into the interior of the orbits.

Great or internal angle, and lachrymal apparatus.—One of the most important points of the orbital region, on account of the frequent manifestations of diseases and the numerous operations performed in it, the *great angle*, uniting the eyelids to the nose, is covered with *skin*, which participates in the characters common to these parts. Much less elastic than on the lids, it is thinner than on the nose, and, on account of its delicacy, abscesses forming beneath it speedily burst, whilst tumours rarely assume any great size before they become disorganized. Beneath the skin is the *cellular tissue*, and next to it the *orbicularis palpebrarum* muscle. This muscle here requires much consideration. Inferiorly, its fibres are attached to the external surface of the ascending portion of the superior maxilla, where they slightly cover the levator labii superioris alæque nasi; superiorly, it is attached to the internal orbital process of the frontal

bone. Between these points, the fibres proceed from a tendon of importance, which we will next examine.

Direct tendon.—About three lines in length and one in breadth, flattened, and attached to the external border of the lachrymal canal, this tendon bifurcates in terminating in the lids, where it becomes continuous with the lachrymal cartilages, and is applied on the fibrous portion of the lachrymal sac, into the formation of which it appears to enter. Its proper tendinous portion is termed the *direct tendon*, whilst the expansion which it furnishes to the sac is called the *reflected tendon*. On account of its transverse position the lachrymal sac is, as it were, divided into two portions, the *inferior* situated in a triangular space, having its base external, the superior side of which is straight, and bounded by the tendon, whilst its inferior border is concave, formed by the external margin of the lachrymal canal and anterior border of the superior maxilla. It is in the apex of this space that the bistouri should be introduced, in opening the lachrymal sac. As the direct tendon receives the fleshy fibres of the two lids, serving as a fixed point of attachment on the nose, all wounds of the palpebral edges in this region are likely to be followed by elongation of the opening of the eye outwards. However, as the cicatrices promptly acquire considerable elasticity, this accident is less common than might be imagined. Inflammations here are rarely of a diffused character, in consequence of the unequal distribution and density of the cellular tissue, and its adhesions with the surrounding parts. As abscesses may occur between the fleshy fibres and the skin, as well as between the conjunctiva, or the lachrymal sac, and the more superficial layers, they may open either externally or internally to the lids, and even into the lachrymal apparatus itself.

Lachrymal apparatus.—The *puncta*, or external orifices of the lachrymal ducts, are situated at the internal extremity of the concave portion of the free borders of the eyelid. Formed by a small cartilaginous ring, they penetrate perpendicularly for about a line, afterwards curving at right angles, to unite with the ducts. When the eyelids are open, they look obliquely between the globe of the eye and the caruncula, whilst they are directed backwards when the lids are closed; thus, they easily absorb the medicated fluids introduced into the great angle, and also the morbid secretions here formed. This explains, on the one hand, how diseases of the lachrymal sac are sometimes cured by collyria, and, on the other, how these diseases are sometimes the result of ophthalmia.

It also occurs from this arrangement, that, in order to introduce any instrument, we must first draw them outwards, and then apply the point of the instrument, perpendicularly, on their opening.

The *lachrymal ducts* follow the course of the straight portion of the palpebral margin, and sometimes unite before they enter

the lachrymal sac, where they then terminate by a single opening. They also frequently merely approach each other, and then terminate in separate openings.

Situated on the posterior portion of the lid, they are protected against the action of external substances. Being separated from the eye and the caruncula only by conjunctiva, their ocular wall is naturally thin and soft, allowing of its being easily perforated by the probe, when we operate according to Anel, Mejan, &c.

The *superior duct*, more easily placed in a parallel direction to that of the sac, by raising the lid towards the head of the eyebrow, should be preferred for passing threads, setons, &c. But, on the contrary, injections should be thrown into the inferior, on account of its transverse position, its firmness, and because it allows of taking a fixed point upon the cheek.

The *lachrymal sac* represents the termination of the nasal canal. Crossed, anteriorly, by the tendon of the orbicularis muscle, above which it forms a fibrous cul-de-sac of about four lines in length, and from one and a half to two, and even three, in width, it lies internally on the bony lachrymal canal, becoming blended with the periosteum, to which it firmly adheres. Externally, it is separated from the caruncula and conjunctiva by a fibrous expansion, and by the tensor tarsi muscle. Fixed, on the one hand, to the superior border of the canal, and, on the other, to the posterior surface of the direct tendon, from which it derives its reflected covering, and situated opposite and above the tendon, it pushes lachrymal humours more particularly downwards and outwards.

Anteriorly, the lachrymal sac is covered by the origin of the orbicular muscle, and some fibrous tissue, which is continuous with the periosteum at the root of the nose; its internal surface is invested by mucous membrane, habitually of a deeper red than that of the lachrymal ducts. Adhering by its external surface to solid immoveable parts, it can neither dilate nor become constricted, in any great degree, in a healthy condition. This circumstance shows the futility of the recommendation of Munro, to introduce a sound by the lachrymal duct, in order to stretch the anterior wall of the sac, during the incision in operation for fistula, as, on this account, if, after directing the bistouri obliquely downwards, inwards, and backwards, beneath the direct tendon, the handle is raised towards the eyebrow, so that it penetrates more deeply, the sac must be entered and cut to a great extent, although the outward opening be very small.

The *nasal canal*, a mere continuation of the lachrymal sac, invested by the same mucous membrane, and adhering to the whole extent of the bony canal, is nearly an inert duct, with regard to the operations which its diseases require; hence the successful employment of the metallic canula.

From five to seven lines in length, and extending a little

more posteriorly than transversely, this canal presents a slight curve, convex anteriorly and externally, whilst the lachrymal sac is slightly convex in the opposite direction. Its inferior orifice has been described with the nasal fossæ.

The bones forming its skeleton require some consideration. As the lachrymal canal is formed, anteriorly, in the posterior border of the ascending process of the superior maxilla, posteriorly, in the external surface of the os unguis, it is better to make the artificial canal for tears in the latter than in the former situation.

The proper *nasal canal*, formed by the prolongation of the lachrymal, has no organ of any importance anterior to it. The nasal fossæ or the maxillary sinus are easily penetrated through its posterior thin and brittle wall, formed by the inferior portion of the os unguis, part of the superior maxilla, and a small portion of the inferior spongy bone.

Its internal wall, consisting of a prolongation of the os unguis and the inferior spongy bone, is not more solid than the preceding. Corresponding to the nares, it may be depressed by polypi or other tumours developed in the nose; whence epiphora, fistula lachrymalis, &c.

Finally, its external wall, constituted by the lamina bounding the maxillary sinus, and sometimes by a small prolongation of the inferior spongy bone, is also thin like the others, and easily fractured or perforated in introducing a probe in the nasal canal, according to the method recommended by La Forest. The maxillary sinus is then entered, in which, for the same reason, tumours rarely acquire any size, without interrupting, or even entirely preventing, the descent of the tears into the inferior meatus.

Enclosed within a bony canal, which resists it at all points, invested by elastic mucous membrane, destined to convey the exhaling humours of the eyelids, together with the tears, from the eye to the nose, the anatomical arrangement of the lachrymal duct sufficiently explains the causes of its constriction, frequent congestions, and obstruction, and the success attending temporary or permanent dilatation, and the various applications used in the treatment of its most common diseases.

Fistula lachrymalis generally appears at the internal extremity of the lower lid, because inferiorly the excretory apparatus of the tears is not dilatable, and, superiorly, it is resisted by the tendon of the orbicularis palpebrarum muscle. As its mucous membrane is very thin, inflammation, ulceration, or suppuration may destroy the fibro-cellular investment, causing necrosis, or caries of the bones; hence the same operation is not applicable to all the varieties of fistulæ, some of which are unhappily incurable.

Between the lachrymal sac and the globe of the eye, on the one part, the palpebral commissure and the lachrymal puncta, on

the other, is situated the caruncula, a small body of a more or less reddish white in the natural state, formed by a fold of the conjunctiva, containing a great number of agglomerate follicles, and also a small cartilage. To this we may add the tensor tarsi muscle, situated behind the lachrymal sac and ducts, to which it is attached, and which it may compress and draw towards the os unguis, its fixed point. Thus, enclosing all the elements of a true eyelid, the caruncula lachrymalis is a rudiment of the membrana nictitans in birds and beasts.

It sometimes gives origin to hairs, which occasionally curve, turning into the eye, causing violent ophthalmia. It was through the internal extremity of the fissure separating it from the inferior eyelid that Ponteau recommended the lachrymal sac to be opened. It has been more recently proposed, with the same view, to commence the incision above the caruncula, and thus open the sac to a much greater extent; but as the tensor tarsi muscles would be divided, and as the action of these muscles assists in the excretion of the tears, these operations are not advisable.

Globe of the eye.—The globe of the eye, of a spheroidal shape, slightly flattened on its four surfaces, is from ten to twelve lines in diameter, from before backwards, and about a line less in the other direction.

Anterior chamber.—The eye is divided into two chambers; the one anterior, limited behind by the iris, and in front by the cornea, is from four to five lines transversely, and very little less from above downwards, and about two lines from the centre of the pupil to the cornea. As it gradually diminishes in approaching the greater circumference of the iris, we should, in penetrating this chamber in keratonyxis, direct the concavity of the needle upwards; otherwise, if the point of the instrument looks backwards, or if we use a straight needle, the pupil is with difficulty reached without injuring the iris.

The *transparent cornea*, appertaining entirely to this chamber, forms nearly the anterior fifth of the eye, wedged, as it were, in the opening of the sclerotica, and describing a smaller circle than the rest of the organ; it is slightly depressed at its circumference, where it corresponds to the iris. Anteriorly, it is invested by a membrane which appears to belong to the conjunctiva, but which does not really possess the character of mucous membrane, except in certain diseases, and which adheres so intimately that they can scarcely be separated by dissection. Thus, several anatomists have maintained that it differs in character from the conjunctiva; but, whatever it be, the fluid constituting phlyctenæ of the cornea collects beneath it. Posteriorly, the cornea is invested by a membrane, termed the *membrane* of the *aqueous humour*. This does not appear to invest the iris, although several exact observers have considered that it does. In my opinion it is the internal, as the preceding was

the external, investment of the cornea. The anterior chamber is filled with a fluid which is speedily reproduced, especially in young subjects.

Wenzel, and most of the French surgeons, recommend that the knife be not carried directly across the anterior chamber, as was the practice of La Faye, but obliquely, from above downwards, and inwards, lest the flap of the cornea should be raised, by the eye turning down, or by the motions of the lower lid. This precept is not so essential as many authors suppose, since it is the upper lid which drops, and not the lower which rises, in closing the eyes of the patient after the operation; neither does the eye itself, should it descend, tend more to this accident. Besides, the oblique incision will not prevent this occurrence, as the external flap will be liable to the same inconvenience. If there be any utility derivable from the idea of Wenzel, it is rather that, in the transverse incision, the flap, being only compressed in its middle portion, allows the iris, or rather the vitreous humour, to raise the extremities, causing hernia at the angles of the eye.*

The *posterior chamber* is extremely complicated. The three membranes of which it is formed, lying one on the other, are from without inwards; the *sclerotica*, *choroid*, and *retina*.

Thicker posteriorly, but strengthened anteriorly by the fibrous expansion of the muscles, the *sclerotica* is composed of parallel fibres, extending from the optic nerve towards the cornea, some of which are circular and transverse.

The *choroid* is formed essentially of vessels; the ciliary nerves ramify between its external surface and the sclerotica. Becoming reflected, to form the *uvea*, it gives origin, by folding on itself, to the *ciliary processes*. These are separated from the *iris* by the commissure of the choroid, on the posterior surface of which they lie.

White, pulpy, and consisting, chiefly, of the expansion of the optic nerve, the *retina* appears to be the proper organ of vision. Situated between the choroid and the vitreous humour, it is prolonged at least to the circumference of the crystalline lens. I have frequently traced it, in man, as far as the iris, and this may be still better seen in the ox.

These three membranes are traversed by the needle in the

* I think that M. Velpeau is in error, in considering that the eyeball is unequally pressed upon by the eyelid, as the concavity of the latter, accommodates itself so exactly to the convexity of the former, as to form a cup for its reception. With regard to the operation for the extraction of cataract, when the lids are closed, the cornea is rolled upwards, as in sleep, covered by the concave surface of the upper lid, which, in these instances, assists union by presenting an equal resistance at all points. The lids should on no account be separated before the fifth or sixth day, or, in point of fact, before union is completed. Thus the situation of the incision is but of little consequence, further than if it be made at the superior portion of the cornea, and the pupil should from subsequent inflammation, or other causes, be obliterated, the inferior half of the cornea remains clear, allowing of further operations for the recovery of sight.—H. H.

operation for cataract. As their fibres are parallel to the axis of the eye, the instrument should be so introduced that its edges look forwards and backwards, whilst its concavity is turned downwards. By acting thus, we merely separate the fibres and vessels; if contrarily, we necessarily divide the parts, and may cause ecchymosis between the conjunctiva and the sclerotica, effusions of blood into the posterior chamber, and injury to the nerve.

Crystalline lens.—The posterior chamber is filled by a globular mass, composed of the vitreous humour and crystalline lens. As the latter is inert and transparent, and more solid in its centre than in its circumference, its opacity is often eccentric. Its capsule is generally separated from it by a space, varying with age, and naturally filled with an albuminous fluid, capable of losing its transparency by passing into a milky or purulent condition. Of a horny, dense, elastic nature, its membrane, enveloped in a sheath of the hyaloid, offers resistance to instruments. Some persons consider that the crystalline itself is secreted by its internal membrane, and that this body may be re-organized after its depression or extraction, if the membrane remains. Hence the necessity of removing the whole in the operation of cataract. M. Campaignac, on the other hand, considers that cataract almost always depends upon an affection of the capsule, which is frequently the case.

The *vitreous humour*, a species of brilliant transparent sponge, is formed of a substance similar to the aqueous humour, and by a membrane the processes of which, interlacing most minutely, form the cells enclosing the fluid. Folded so as to form the hyaloid canal, which, traversing the whole thickness of the vitreous humour, transports an artery to the lenticular capsule, the *hyaloid membrane* near the iris separates into two layers, which enclose the lens between them. Objects are impinged at the bottom of the posterior chamber.

We here find the retina, with its folds and yellow spot, about two lines from the optic nerve, that is to say, nearly in the direction of the axis of the eye; the choroid, which is pierced for the entrance of the optic nerve; finally, the sclerotica, traversed in man by the same nerve, at about two lines internal to the axis of vision.

This chamber is separated from the anterior by the *iris*, a membrane placed edgewise, the central opening of which forms the pupil. Of a very complicated structure, this organ, according to some anatomists, consists of a prolongation of the retina, of the choroid, of the membrane of the aqueous humour, and a proper cellulo-vascular layer. Formed essentially by the long ciliary arteries anastomosing four or five times in circles, it is considered by some as an erectile tissue, by others as a double muscle. Neither of these opinions appears to be exact. The cellular tissue forming the base of the iris explains

its inflammations, and its numerous vessels account for the hemorrhage on the slightest injury. Its shining anterior appearance indicates a serous *surface*, rather than *membrane*.

The choroid investment of its posterior surface adheres so closely that it is impossible to separate the slightest layer; so that, if it encloses the several elements admitted by authors, it must be in a homogeneous condition, and not in distinct membranes. As to its fleshy fibres, surgery does not recognise them. Instead of becoming enlarged by the action of the circular muscle, which has been bestowed upon it by some authors, wounds of its free border rarely fail to unite; and when a triangular flap has been removed, it often reunites of itself, instead of retracting.

Projecting slightly in some individuals, and especially in infants, the anterior surface of the iris may be injured by the needle, at the moment when traversing the anterior chamber the aqueous humour escapes. Its posterior surface or uvea, slightly concave and black, is separated from the membrane of the crystalline by an interval of half a line, filled with aqueous humour. The narrowness of this space renders it extremely difficult to introduce a needle into it, without injuring the vitreous humour; more especially as, like the cornea, at first separated two or three lines from the pupil, it approaches at its greatest circumference so close to the iris, that it appears in immediate contact with the ciliary processes. The great circumference of the iris being attached at the union of the cornea with the sclerotica, anterior to the ciliary circle, and receiving the principal vessels entering into its composition, the operation for artificial pupil, according to Scarpa, may cause the nervous ring to be torn, and produce considerable hemorrhage.

The small circumference of the iris is capable of alternately dilating and contracting. Wenzel, by introducing the point of his knife anterior to it, passed into the posterior chamber, and divided the capsule of the lens, at the same time that he formed the flap in the cornea. It is thus that the lens may be punctured in keratonyxis.

The *vessels of the eyeball* are exceedingly numerous and minute. Branches from the *palpebral* and *anterior ciliary* are distributed to the conjunctiva. The central artery of the retina enters through the optic nerve, gives several branches to the *tunica vasculosa*, and proceeds, under the name of the central artery of the lens, along the hyloid canal, as far as the posterior layer of the lenticular capsule; I have never seen it penetrate the lens itself. It should be avoided in depression, as it is probable that its destruction would, in some degree, affect vision.

The *ciliary arteries* all pierce the sclerotica obliquely, and, principally, at its posterior third. Their numerous filaments are then distributed to the choroid, proceeding as far as the ciliary processes, with the exception of the two long ciliary

branches; which, situated on the internal surface of the sclerotic, continue to the great circumference of the iris before they divide. As these two branches are situated at each extremity of the transverse diameter of the eye, the needle, in the operation for depression, should be introduced beneath this point, with its cutting edges directed forward and backward.

The *veins*, for the most part, empty themselves into the *choroid*. Besides these, situated between the coat and the vitreous humour, are the *vasa vorticosa*, which pierce the sclerotic, and empty themselves into the lachrymal vein.

The *nerves* of the *ophthalmic ganglion* are divided like the arteries which they accompany, terminating in the ciliary circle; a ring possessing all the characters of a circular nervous ganglion, and of a prismatic shape.

Corresponding, by its external side, to the most anterior portion of the internal surface of the sclerotica, the *ciliary circle* separates the iris from the choroid, to which it adheres posteriorly. This point of the eye is of importance; it has been recommended, in extraction of cataract, in order to avoid the iris, that the anterior chamber be penetrated about half a line anterior to the sclerotic. In depression, if we penetrate even less than a line and a half, posteriorly, we inevitably injure the great arterial circle of the iris, the ganglion, or, finally, the ciliary process.

The *nerves* of the eye may be arranged in three classes. The first, destined for the motions of the iris, proceed from the nasal branch of the ophthalmic, and from the lachrymal; thus, wounds of the angle of the eye may suspend the contractions of the iris, without destroying vision. The second order includes the nerve of special sensation, which, according to Majendie, is not endowed with general sensibility, being only destined to receive the impression of objects. Its disposition explains why paralysis of the retina does not change the condition of the other parts of the eye, and why it does not, of necessity, produce paralysis of the iris. Finally, the nerves of the third class appertain to the ganglionic system; these are the filaments of the ciliary circle.

Relations.—From before backwards, the order of parts is as follows: —

1. The layer covering the cornea.
2. The transparent cornea.
3. The membrane of the aqueous humour.
4. The anterior chamber.
5. The aqueous humour.
6. The iris, pupil, or pupillary membrane.
7. The space separating the iris from the lens, scarcely existing in infants, and being only about half a line in extent in adults, and considered by some authors as the proper posterior chamber.

8. The anterior portion of the lenticular sac, covered by the hyaloid membrane.

9. A small space separating the anterior surface of the crystalline from its capsule, filled with liquor Morgagni.

10. The crystalline lens, softer, rounder, and more projecting in infants than in old people; hence myopia in the one, and presbytia in the other.

11. Between the posterior surface of the body and its membrane, another space, filled with a fluid similar to that which is anterior.

12. The posterior portion of the lenticular sac, thicker and denser than the anterior, and invested, posteriorly, by the hyaloid membrane.

13. The vitreous humour, hyaloid canal, and central artery of the lens.

14. The retina, formed of its three lamellæ.

15. The choroid.

16. The sclerotica.

Transversely we find—

1. The sclerotic.
2. The choroid.
3. The retina.
4. The hyaloid membrane.
5. The vitreous humour.
6. The hyaloid canal, the central artery of the lens, or rather the lens itself, and its membrane.

For the anterior chamber,—

1. The conjunctiva.
2. The cornea.
3. The membrane of the aqueous humour.

And then the same parts on the other side of the axis.

The horny texture of the transparent coat of the eye renders incisions into it scarcely painful, and causes simple wounds to unite with great facility.

The vessels which sometimes cover its surface do not demonstrate the existence of a prolongation of conjunctiva anterior to it. Frequently proceeding from the centre towards the circumference, they are produced by new formation, and not only by exaggeration of the normal condition; on which account I think that the application of nitrate of silver, at the commencement, to the speck, ulcer, or morbid point of the cornea, is sometimes more efficacious than operations at a later period.

Practical considerations. — When the eye is frequently attacked with dropsy, it depends, on the one hand, on the serous surface of the anterior chamber, and, on the other, on the membrane of the same character, situated between the retina and the choroid, where Messrs. Mirault, Camus, &c. have observed serum accumulate. In like manner staphyloma of the cornea or sclerotica arises from weakness or greater nutrition of one

point than another. The elasticity of the iris allows it to relax and fall on the knife in the operation for cataract; and in the operation for artificial pupil, it embarrasses, by folding on itself, and being with difficulty divided.

The resistance of the sclerotic membrane is the cause of so much pain in augmentation of the humours; from its fibrous nature it frequently becomes transformed into bone. The vascular structure of the choroid explains its melanotic degeneracies, and the cellular nervous texture of the retina, the fungoid appearance habitually presented by cancer of the eye.

Softs parts of the orbit.—There are numerous objects within the orbit external to the eyeball.

Muscles.—The *recti muscles* form a cone, the apex of which is attached to the bottom of the orbit, pierced at its centre by the optic nerve. Their fibrous expansions terminate on that portion of the sclerotic, which is covered by conjunctiva, constituting what is termed the tunica albuginea. By contracting at the same moment, they flatten the eye, and draw it moderately backwards, thus frequently causing the expulsion of the vitreous humour in the operation for the extraction of cataract.

The *levator palpebræ superioris*, situated between the superior rectus and the periosteum, draws the eyelid upwards and backwards.

The *superior oblique* is situated between the internal rectus, the superior rectus, the elevator of the eyelid, and the periosteum, as far as its pulley, at three lines internal to the supra-orbital notch. It then proceeds backwards, behind the conjunctiva, between the levator, the superior, and external rectus, to the sclerotic, where it is inserted about three lines anterior to the optic nerve. Its superficial position at its point of reflection exposes it to various injuries; to be divided, for example, in the section of the supra-orbital nerve, depriving the patient of the power of rotating the eye inwards.

The *inferior oblique*, attached close to the circumference of the inferior wall of the orbit, at about two lines external to the superior opening or orifice of the nasal canal, proceeds from this point, behind the conjunctiva, obliquely upwards, outwards, and backwards, between the periosteum, the inferior, and external rectus, to the sclerotic. In the operation for fistula lachrymalis, if the knife is allowed to slip out of the sac, it may be cut across, in consequence of the smallness of its tendon and its position; the result of this accident is loss of the rotary motion outwards. These two latter muscles are so disposed that they antagonise the recti by drawing the eye forwards.

Nerves.—Enveloped by the origin of the muscles, posteriorly, and by fat anteriorly, the optic nerve is with difficulty compressed. The ciliary nerves are derived from the ophthalmic ganglion, lying on the external surface of the optic nerve, a little anterior to the attachment of the muscles.

The motor oculi nerve (third) enters the orbit through the foramen lacerum, crossing the posterior extremity of the external rectus muscle. Its superior branch terminates in the superior rectus and levator palpebræ superioris. The inferior gives a large branch to the inferior rectus, another to the inferior oblique, a third, which passes beneath the optic nerve, going to the internal rectus, and a filament to the lenticular ganglion. The sixth pair enters the orbit through the same foramen as the preceding, and is immediately distributed to the external rectus.

All these branches, placed external to and around the optic nerve, supply the motor muscles of the eye. According to the researches of Sir Charles Bell, these are the nerves which preside over the voluntary motions within the orbit. The pathetic, according to this author, produces the instinctive motions of the superior oblique, and unites with branches of the facial, which are the motors of the orbicular muscle. In fact, at the moment of sleep, as at the approach of death, when the upper lid drops the cornea is turned upwards, by the action of the superior oblique, from the will not acting upon the recti muscles, which only obey its directions. On the other hand, if we destroy the facial nerve, the eyelids remain open and fixed, whilst the eye continues to move under the influence of the will. The patient in whom Beclard extirpated the parotid gland presented an example of the latter fact; I have myself seen the same take place in three subjects. It must, however, be observed, that in another recorded by Bilard the trunk of the facial nerve had been destroyed, and the side of the face paralyzed, while the lids retained their power and motion.

The branches of the fifth appear to be exclusively endowed with sensation; thus, when the trunk of the ophthalmic is divided, the patient can no longer feel the contact of any bodies against the eyelids or eye. Before it is lost in the gland, and external angle of the eye, the lachrymal branch gives off two small filaments, which traverse the malar bone ending in the temporal fossa, and forming, with a branch of the inferior maxillary, the superficial temporal.

The supra-orbital, situated on the superior surface of the elevator of the upper eyelid, before leaving the orbit, anastomoses with the nasal by its internal frontal branch. This latter, in passing over the optic nerve, gives off a branch to the lenticular ganglion, and proceeds to the internal wall of the orbit, between the superior oblique and the internal rectus, giving off the ethmoidal branch, and terminating at the internal angle. The inferior maxillary nerve gives off in the orbit the infra-orbital nerve, which lies in the canal conveying it to the infra-orbital fossa. The orbital branch, anastomosing with the lachrymal and the deep temporal branches, is also met with.

The *lachrymal gland* is hidden behind the external orbital

process, so that in extirpation of the eye, where the disease has implicated this gland, it must be removed individually. All these organs are separated by cellulo adipose-tissue, which is never absent, how thin soever the patient be. Soft, and nearly semi-fluid, this forms an elastic cushion, favouring the motions of the eye, and preventing the straight muscles from drawing it too much backwards. On account of the looseness of this texture, inflammation of the interior of the orbit quickly terminates in suppuration, rapidly leading to the disorganization of the parts.

General remarks on the vessels of the orbital region.

The *lymphatics* of the orbit, being continuous with those of the face, proceeding through the spheno-maxillary fissure, run to the parotid region.

The *arteries* derived from the ophthalmic are distributed like the nerves. Taken individually they are not of sufficient size to require any surgical remarks.

The supra-orbital may be wounded in fractures of the roof of the orbit.

The middle meningeal also sometimes sends in a large branch through the sphenoidal fissure, which replaces the lachrymal. In extirpation of the eye it is unnecessary to tie these, their position and relation to the bones allowing them to be easily compressed. As they proceed from the carotids several surgeons have applied a ligature on these latter for the cure of aneurismal tumours developed in the orbit. The vessels, however, are of such real importance here, with regard to the pathology of the eye, that they require some consideration. The arteries of this region all come from the ophthalmic branch of the internal carotid. In tracing them with attention we perceive that they are not indiscriminately distributed to the same tissues, but that they are arranged in four groups, one destined to the eyelids, another to the conjunctiva, a third to the sclerotica, and a fourth to the interior of the eye. These communicate with each other by free anastomoses.

Eyelids. — The arterial system of the lids consists of three principal branches, the nasal, lachrymal, and frontal. The divisions of the temporal, infra-orbital, transverse, and angular arteries of the face with which they communicate, do not properly appertain to this system, but they place the eyelids under the influence of a double circulatory system. It has been ascertained, moreover, by the assistance of fine injections, that the palpebral arteries are almost entirely lost in the ciliary bulbs, and in the laminæ separating the tarsal cartilages from the epidermis. On the contrary, the meibomian glands and the conjunctiva, investing the free border of each lid, are supplied by some branches of the nasal, and especially those of the lachrymal

artery, so that we here find a primitive tendency to the isolation of the blood vessels of each separate organ; that the neighbourhood and skin of the eyelids derive a portion of their arteries from those of the cranium and face; that the tissues intermediate to the integuments and the fibro-cartilaginous layer are supplied from the palpebral arteries, and finally, that the deep glands and mucous membrane receive branches from the lachrymal and nasal.

Conjunctiva. — Two orders of arteries may be perceived in the conjunctiva; the one derived from the arteries of the lid, the other supplied by the superior and inferior muscular branches.

Both these orders are intermediate vessels, and not proper to the conjunctiva. This membrane, however, is well supplied by vessels ramifying in its tissue in a tortuous arborescent manner, frequently anastomosing with each other, especially as they approach the cornea or the adherent border of the tarsus.

It is also here that they anastomose with those of the interior of the eye. Thus the arteries of the conjunctiva are but secondary ramifications of the muscular branches of the orbit; and those running to the eyelid are ramifications, which, having supplied the mucous membrane with a very complete plexus, terminate by uniting with the ciliary or deep palpebral arteries.

Sclerotica.—Like other fibrous membranes, the sclerotic encloses but few blood vessels; it may perhaps contain more than any other membrane of the same character, especially at its anterior third. They are nearly all derived from the muscular arteries, which, having furnished branches to the muscles and cellular tissue of the orbit, approach the eye, ramifying in the substance, or on the surface of the tendons, and thus arrive at the proper substance of the sclerotica, close to the cornea, forming an irregular ramification, independent of that of the conjunctiva, and also in a great measure of that of the choroid. Their most evident branches are very superficial, and appear especially destined for the dense compact tissue which more immediately invests the external layers of the eye-ball, and which finally unites with the sub-mucous membrane of the conjunctiva. Some of their capillary branches are prolonged as far as the cornea, in such a manner as to anastomose with those of the conjunctiva externally, and iris internally; consequently the arteries of the conjunctiva and the sclerotica arise from the same trunks, and again become united at their extremities, although through their greatest extent they remain separated in quite distinct layers.

Interior of the eye.—Of the arteries which enter into the eye hrough its posterior portion, one, the centralis retinæ, is entirely distributed to the nervous membrane, with the exception of the branch perforating the vitreous humour, to spread out behind the capsule of the lens. The others, the ciliary, distri-

buted principally to the choroid and iris, merit especial consideration. Of these there are four; two for the transverse, and two for the vertical diameter. An infinity of small arterial branches are met with between these latter; the whole represents a convergent ring, of extremely fine radii, distributed like those of the ciliary processes, and appearing to leave the choroid, in order to reach the internal layer of the sclerotic or the circumference of the cornea. A series of capillaries also proceed from this point towards the exterior, anastomosing with the arteries of the conjunctiva, and those of the sclerotica derived from the muscular. This plexus, therefore, nourishes at the same time the iris, the ciliary circle, and the anterior of the sclerotica. The communications between the interior and exterior of the eye are entirely dependent upon this arrangement; and thus also the arteries which sometimes penetrate the cornea may appertain to the vessels of the conjunctiva, of the anterior of the choroid, and even to those of the sclerotica.

The *veins* generally accompany the arteries, and are larger. One more voluminous than the rest, proceeding from the face to the sella turcica, forms a direct communication between the angular and the ophthalmic. This communication, which explains, in part, why diseases of the organs contained in the orbital cavity are so easily transmitted to the brain, and reciprocally, proves also that, in diseases of the eye, the opening of the facial vein produces prompt relief, and that it is probably too much neglected at the present day. Entering the cranium through the sphenoidal fissure, these veins form, before emptying themselves into the coronary sinus, a complicated plexus, which may be termed the ophthalmic plexus.

The veins of the conjunctiva are large and very numerous; they are also considerably developed in the substance of the lids, where they communicate freely with the temporal, infra-orbital, and frontal. In the interior of the orbit, behind the conjunctiva, they form an arrangement of but little interest in a surgical point of view. In the choroid also their distribution is sufficiently remarkable.

The following peculiarities are matters of fact, and the anatomical descriptions of Zinn and Soemmering may have already given insight into them.

Vessels of the orbit in ophthalmia.—Ophthalmia is considered for the most part as dependent upon the vascular system of the tissues in which it commences. If this be the case, the preceding remarks cannot fail to establish the wide and fundamental distinction between inflammation of the eye and its appendages. Thus ophthalmia may occur in the cornea, conjunctiva, or lids, and sometimes in several of these parts at once.

Lids.—In the cutaneous layer of the lids, and in the various lamellæ separating the skin from the conjunctiva, diffused inflammation is accompanied by swelling and discolouration,

which is more marked the farther it is from the free margin. The softness and vascularity of these tissues, being much greater the nearer they approach the circumference of the orbit, perfectly explain this phenomenon. When the inflammation exclusively occupies the mucous membrane, the sanguineous congestion, but little marked near the free border of the lids, increases in intensity towards the oculo-palpebral fossa. This is in direct relation with the order in which we have met with the conjunctival branches of the muscular arteries. When, on the contrary, the disease commences on the edge of the lids, or in the Meibomian follicles, it generally remains stationary, and the redness is much more marked as it approaches the ciliæ. It is here that the vessels of the conjunctiva anastomose with those of the ciliary follicles, forming an abundant plexus in the centre of dense tissue, whilst further off they remain in the substance of tissues, so loosely united to each other as to be almost separated.

Conjunctiva.—Inflammations of the conjunctiva have still more distinctly marked anatomical characters than those of the lid. The pink or scarlet colour of the affected membrane quickly changes to violet, because the veins are here in the greatest proportion; it is deeper, the further from the cornea, because the arteries coming from the muscular are fewer and finer in the opposite direction. As the muscular arteries proceed towards their termination, by dividing and subdividing like the branches of a tree, the vessels here are tortuous, frequently anastomosing among themselves.

Finally, they with difficulty extend over the cornea, unless the deep-seated parts are also affected, as the proper vessels of the conjunctiva stop at some distance from this membrane.*

Cornea.—Containing no vessels visible in the normal condition, the cornea is but seldom reddened at the commencement of its diseases, the inflammatory tint being manifested around its circumference. This appears to be situated in the sclerotica, and shows itself under the form of a radiated ring, which is deeper coloured near the cornea, paler posteriorly, from two to three lines in breadth, of a vermilion or carmine colour, and depending evidently on injection of the ciliary or choroid vessels. Instead of a complete ring, there may exist a few red spots at the circumference of the cornea, in which case the inflamed points correspond more directly to the extremities of the vertical and transverse diameters of the eye, where the four primitive ciliary arteries are situated. However, irritation of the cornea is frequently accompanied by

* The vessels of the conjunctiva are continued with that membrane over the cornea. In the healthy condition of the eye these vessels carry colourless blood; but in intense inflammation, especially that occurring from granulation of the lids, the vessels of the conjunctiva can be distinctly observed running from it, directly over the cornea, enclosed in a prolongation of that membrane. In ulceration, also, and pustular inflammations of the cornea, vessels are seen ramifying in the conjunctiva, and conducted by it over the cornea to the point of disease.—H. H.

vascularity of the conjunctiva; but this is almost entirely confined to cases of superficial irritation, and is not at all surprising, as the conjunctiva and the surface of the cornea are continuous, as if they formed a single membrane.*

When the inflammation is prolonged or becomes intense this red ring extends to the cornea itself, but the conjunctiva does not of necessity participate in the mischief. At this period the ring presents two sets of radii; one more separated and irregular, passing forwards, becomes nearly superficial, and may extend and anastomose over the anterior portion of the pupil: the other deeper, more compact, and parallel, remains behind the ciliary circle, being merely an increased developement of the natural ciliary arteries. In these inflammations the iris frequently changes colour, and the pupil its form, sometimes in one direction, sometimes in another, because this membrane is nourished by the same order of vessels. The red circle indicating irritation of the cornea disappears posteriorly, in consequence of the greater degree of thickness and opacity of the sclerotica in that direction.

Finally, if the injection of the sclerotic itself is but rarely well marked, it is on account of the arteries of this coat being few in number, and anastomosing but seldom with those of the conjunctiva and ciliary margin of the cornea.

When the cutaneous portion of the edges of the lids is rounded, red, or scabby, we may affirm that the disease is situated in the roots of the eye-lashes, or in the dense tissue separating the cartilages from the integuments, and that it is only nourished by concentric branches derived from the palpebral arch of the orbicular arteries.

Redness of the skin, with diffused tumefaction above the ciliary margin, indicates, on the contrary, inflammation, or infiltration, in the lid itself, in some degree dependant upon the vessels of the face and forehead.

Viewed on the internal surface, the inflamed lid presents a redness, which sensibly increases or diminishes, as it approaches the orbit. In the former case, the palpebral conjunctiva is affected; in the latter, the disease is situated in the meibomian glands. When the whole substance of the free margin is swollen, red, or excoriated, we may conclude that the vessels of the skin, of the mucous membrane, and glands, all concur in the mischief.

In every case where the eye assumes a scarlet hue, we may be sure that the conjunctiva is the seat of mischief, when the vascular plexus is large, moveable, bluish, or violet colour, rather than of a vermilion or deep rose tint, and especially when the colour is deepest at the point farthest from the cornea. There is, on the contrary, inflammation of the cornea in all those diseases where the colour is deeper seated, immoveable, and occu-

* M. Velpeau here confirms what I have stated in the preceding note.—H. H.

pying the anterior circle of the sclerotica, sometimes so light as to be scarcely distinguishable, and becoming gradually lost at some lines from the cornea. This redness, arranged in minute and parallel radii, is of a pale carmine, vermilion, or rose pink, extending from the cornea, indicating a disease foreign to the conjunctiva, and serving as a prelude to most of the alterations affecting this membrane. When the pupil is at the same time deformed, too much contracted, or dilated, the iris itself is implicated in the mischief, which also menaces the walls of the anterior chamber. These characters are so well marked that everybody must appreciate them, their combination not preventing their being easily recognized in the most serious and complicated diseases. The plexus of the mucous membrane is distinguished by its livid tint (more marked posteriorly), by its mobility and tortuosity, from the fixed and deep-seated scarlet ring of the sclerotica, which it appears to veil, by crossing its different radii. The same thing is observable in the palpebral conjunctiva, as here the vascularity equally decreases at the mucous membrane, and increases at the follicles, where it approaches the free border of the lids, there presenting the same characters as over the eye itself.

Of the skeleton of the orbit.—The *periosteum* of the orbit is divided into two portions, and appears to be derived from the dura mater. One of these, serving as an envelope to the optic nerve, is lost on the sclerotic; the other, investing the bones, proceeds to the base of the orbit, appearing, on the one hand, to form the palpebral ligament, and, on the other, to continue with the periosteum of the forehead.

The roof of the orbit is formed by the orbital portion of the frontal bone, excepting at its posterior tenth, where it meets with the lesser wing of the sphenoid. Pierced obliquely, forwards and outwards, by the optic foramen, giving passage to the ophthalmic nerve and artery, it is so thin and brittle that it may be easily penetrated, thus leading to serious mischief, not unfrequently to death.

The floor or inferior wall, formed, anteriorly and externally, by the malar bone, and, for the rest of its extent, by the orbital process of the maxillary and palatine bones, presents two sutures adhering firmly to the periosteum, and receiving the emissary veins. Traversed posteriorly by the *infra-orbital canal*, containing the artery, nerve, and vein of the same name, injuries at this point are attended with great danger. Being very thin, and corresponding to the maxillary sinus, tumours of this latter cavity quickly compress the eye, and tend, in augmenting, to push it outwards; for the same reason instruments are easily forced into this cavity; thus, in the operation for fistula lachrymalis, if the bistouri is introduced too far backwards or outwards it may penetrate, leading the surgeon to consider that he has entered the nasal canal.

The *internal orbital wall*, placed in the direction of the antero-posterior axis of the head, is formed by the os unguis, the pars plana of the ethmoid, and, quite posteriorly, by a small portion of the sphenoid. Its sutures present no peculiarity, with the exception of the fronto-ethmoidal, in which are placed the internal orbital foramina, through which the ophthalmic artery and nerve send their branches to the ethmoidal cells, dura mater, and nose.

The *external wall*, formed by the malar bone, anteriorly, and the great wing of the sphenoid, posteriorly, is solid, resisting, and corresponds to the temporal fossa. The sphenoidal fissure separates this from the roof, giving origin at its internal portion to the superior and inferior recti muscles. The common motor, pathetic, ophthalmic, and abductor nerves, together with some branches of the great sympathetic and the lachrymal veins, enter the orbit through this opening. A cutting instrument may easily penetrate through this into the cranium, and wound the brain.

The spheno-maxillary fissure separates the external and inferior regions of the orbit; more simple than the preceding, it is filled by fat, dense cellular tissue, and the infra-orbital nerve and vessels. It presents great facility for the entrance of foreign bodies into the zygomatic and pterygo-maxillary fossæ. If, in extirpation of the eye, the bistouri should enter at this point, it might injure the internal maxillary artery, the superior maxillary nerve, Mechel's ganglion, &c.

The *base* of these four surfaces forms the circumference of the orbit, which, smooth and rounded internally, forms a more or less prominent border externally; consequently, in extirpation of the eye, we should introduce the bistouri at the internal angle, cutting at first, from within downwards and outwards, and afterwards, from within upwards and outwards, to reach the temporal angle, rather than commencing externally. We thus run less risk of introducing the instrument into the sphenoidal and spheno-maxillary fissure. By this first incision we only divide the palpebral conjunctiva, the inferior oblique muscle, and the cellular tissue uniting the muscles to the orbit. By the second we cut through the tendon of the superior oblique, a layer of cellular tissue, denser in this situation than inferiorly; and if we carry the bistouri sufficiently close to the bone, the lachrymal gland is next separated from its fossæ. The eye is now only retained, at the apex of this cavity, by a pedicle composed of the four recti, the superior oblique and levator palpebræ superioris muscles, the ophthalmic vessels, optic and all the other nerves.

In consequence of the conical form of the orbit, the various tumours formed in it tend to push the eye out towards the face; but the swelling of the cellulo adipose tissue may also produce the same effect, and explains how exophthalmiæ in some instances

are less serious than appears at first sight. The relation between its cellular tissue and the nerves and vessels accounts for the violent reaction of its inflammations, and their terminating in suppuration; its continuity with the temporal or zygomatic fossæ by the spheno-maxillary fissure, with the cranial cavity by the sphenoidal fissure, shows how pus or any morbid growth may thus escape from the orbit, and also how similar affections, commencing in its neighbourhood, may extend into it.

SECTION FOURTH.

THE CHIN.

Bounded, superiorly, by the labial fissure, inferiorly, by the supra-hyoid region, the mental region presents a prominence, at the most inferior portion of the face, varying with age, sex, size, &c., and frequently offering in the centre a fossa, during the elevation of the inferior lip, or a depression, corresponding to the symphysis. Thicker than in the preceding regions, the *skin* assimilates in character to that of the cranium, that is to say, it is dense, compact, and very adherent. Traversed, perpendicularly, by the numerous hairs which adorn the male adult, constituting the beard, it contains numerous, but slightly developed, sebaceous follicles.

The *cellular tissue* is not abundant, neither does it form the subcutaneous layer; being confounded with the muscles, it is merely attached to the skin by short compact filaments, and is distinct only posteriorly between the muscles and the bone. Its adipose vessels are numerous, and exceedingly minute, but as they rarely increase in volume, the size of the chin, properly so called, scarcely ever varies. The pilous bulbs are situated in the cellular tissue, between the muscular fibres, close to the integuments. The dense texture of this tissue, and its intimate union with the skin, prevents the formation of abscess, and causes inflammation of this region to assume the erysipelatous character.

Muscles.—On each side of the chin is a small portion of the depressor anguli oris, the fibres of which ascend, backwards. More anteriorly are the depressores labii inferioris, uniting with each other in the median line; some fibres also of the platisma mingle with those of the preceding, covering the depressor anguli oris. In the centre, within the triangular space formed by the divergence of the two depressor labii muscles, is the levator labii inferioris, a small muscle, attached by two pedicles to the sides of the symphysis, and inserted into the skin. Invested by the mucous membrane of the lip, superiorly and posteriorly, it is partly covered by the depressor muscles anteriorly; and as its fibres are perpendicular to the axis of the body, they

must, in contracting, draw the skin towards the jaw, thus raising the lip.

Arteries.—The termination of the inferior dental artery lies between the bone, mucous membrane, and the depressor labii muscles. Inferiorly, the branches of the submental amastomose with others derived from the inferior coronary. The facial artery also gives off some twigs, beneath the origin of the inferior labial. These are all too small to cause serious hemorrhage in wounds of this region. But in operations it is difficult to apply a ligature upon them, as, contracting within the muscles and cellular tissue, they cannot be reached by the tenaculum.

The *veins* are disposed like the arteries; some large, and subcutaneous, descend to the supra-hyoid region, and empty themselves into the lingual or external jugular. As they ramify, principally, in the skin, they may become varicose, causing that red tint so frequently met with in some individuals.

The *lymphatics* pass, almost immediately, into the submaxillary gland.

The *nerves* come from the neck, the inferior maxillary bone, and the genal region. The former are derived from the mylohyoid, and from the submental branch of the cervical plexus; the latter are filaments of the inferior facial. They are all superficial. The dental, emerging through the mental foramen, is more deeply seated; supplying the muscles, it is so placed that, in neuralgia, it may be divided without the slightest danger, as, in that case, it will be quite sufficient to cut into the inner surface of the lip, opposite the canine or first molar tooth, when the nerve will be exposed, lying, at a depth of some lines, upon the bone, surrounded by cellular tissue, and covered by the depressor muscle.

Consisting solely of the body of the inferior maxilla, the *skeleton* presents, on the median line, the symphysis, so slightly united in the infant as to be easily separated by a blow, &c. Beneath this line we observe a triangular surface, covered only by skin. The mental foramen is situated, externally, close to the limits of this region, opposite the first molar tooth. Thus, a large portion of the chin may be removed without injuring either this foramen, or the dental nerve.

In the adult the maxillary bone is so thick, in this region, that direct fractures have been considered as almost impossible by some authors. The projection formed by it, larger in the infant, again augmenting in old age from the loss of teeth, although well marked in the adult, is rounded and obtuse at that period of life. The periosteum presents nothing of peculiarity; but as the muscles are separated from it by cellular tissue, much more distinct than that immediately beneath the skin, inflammations near to the bone are mostly of a phlegmonous character. The various tissues, also, being very thin in this situation, abscesses, and collections of fluids, present towards the mouth, rather than

the surface; we should, consequently, open them in the former situation, as by so doing we give less pain, and also avoid the cicatrix, externally.

SECTION FIFTH.

LABIAL REGION.

Comprehending the two lips; limited, superiorly, by the nose and naso-labial depression; inferiorly, by the mento-labial fossa; laterally, by the angles of the lips; this region is of an elliptic shape.

Superior lip.—Its *external surface* presents, in the median line, a species of circumscribed gutter, formed by two ridges, descending, from the nose, towards the mouth. According to some anatomists, these two crests are the remains of the cicatrisation of the three primitive portions of which the lip consisted, during the period of uterogestation. Simple hare-lip, consequently, would depend upon union not having taken place in one of these situations, and would never occur in the median line; whilst the double would depend upon defect of union in both; but, from my own experience, I consider this as incorrect. Its *free border*, slightly convex, the concavity looking downwards, is divided into two, in the median line, by a small projection, which is the termination of the gutter. As this enters into the normal conformation, we should endeavour to re-establish it, in the operation for hare-lip; it is, therefore, with this intention, that the first needle, in traversing the parts, should describe a semicircle, the convexity of which should look backwards, and upwards.

Skin.—Thinner here than on the chin, it is still more intimately connected with the subjacent tissue, the nearer it approaches the free border of the lip. Approaching this border, it becomes thinner, and completely changed in character, forming a delicate rose-coloured cuticle, which is continuous, posteriorly, with the mucous membrane. It is traversed by hair, as the chin, and encloses sebaceous follicles.

The *cellular tissue* is very fine, existing in so small quantity that it is scarcely distinguishable from the other elements, which are so blended as to form a homogeneous mass. Its adipose vesicles are also smaller than those in the mental region.

Muscles.—Besides the superior half of the orbicular, we often see, in the centre of the anterior surface of the upper lip, two small fasciculi, ascending perpendicularly towards the sides of the nasal septum, corresponding to the prominences already described; these have been termed the superior incisor muscles. Behind the labial and the mucous membrane, on the sides of the anterior nasal spine, is situated the depressor labii superioris

muscle, lying on the bone. The convex border of the orbicular receives, from within outwards, the termination of the common and proper elevators, of the zygomaticus minor, and of a portion of the buccinator. When these muscles are attached to the internal surface of the skin, without descending to the orbicular, it is an exception, and not a general arrangement, as considered by M. Blandin. The union of the orbicular with the mucous membrane is less intimate than with the skin, and effected by means of a thin layer of cellular tissue, containing numerous glands. The mucous membrane being more easily separated from the muscles at its point of reflection, over the maxillary bone, explains why abscesses of the lip most commonly occur there.

Arteries.—The superior coronary, derived from the facial, as it passes towards the external extremity of the naso-labial fossa, is situated about three lines above the free border of the lip, in the posterior layer of the muscles, the direction of whose fibres it follows, giving off a large branch to the septum of the nose, before it unites with the artery, on the opposite side. A transverse incision, in the median line, might divide the ascending arteries, causing hemorrhage; whilst the same injury occurring rather more externally, would not produce any, unless it were prolonged to the naso-labial depression, close to which the facial artery itself winds. The superior coronary arteries give off an immense quantity of branches, descending or mounting, parallel to each other, and terminating, for the most part, in the labial gland, and mucous membrane, where they form a minute plexus, easily seen by everting the lip. As the trunk of this artery lies almost immediately beneath the mucous membrane, it is more easily hurt interior than exterior to the mouth. The artery of the ala of the nose sometimes, also, supplies a branch, and the facial itself not unfrequently penetrates, more or less, into the orbicular muscle, before it passes into the interval between the nasal and zygomato-maxillary regions.

The *veins* are more numerous, and larger, than the arteries, ramifying in the proper tissue of the lip, where they frequently become varicose. The numerous vessels explain the frequency of erectile tumours, and the active swelling of which the upper lip is susceptible, in the normal condition. The intermingling of its anatomical elements, also, accounts for the rapidity with which it becomes hypertrophied, and the considerable size it acquires in acute inflammation. Being partly supplied by the arteries of the orbit, and of the nose, erectile tumours of the upper lip yield neither to compression nor ligature of the facial.

The *lymphatics*, like those of the nasal region, pass into the submaxillary gland.

Nerves.—The upper lip receives many nerves, without having any proper to itself. These are the terminating filaments of the *infra-orbital*, *buccal*, and of the *temporo-facial* branch of the

seventh pair. These sufficiently explain the exquisite sensibility of this region, and the intense pain accompanying acute diseases.

The portion of the skeleton supporting the upper lip, formed by the anterior surface of the maxillary bone, and the alveolar arch, corresponding to the canine teeth, presents, in the median line, the symphysis of the superior maxillary, surmounted by the anterior nasal spine; a little externally, the canine fossa, and, finally, the undulating surface of the alveoli, and exterior of the teeth. The maxillary bone offers its greatest resistance in this region, and is rarely fractured. It is not unfrequently split from before backwards, a little external to the median line; and we sometimes meet with an apparent fissure on each side, a peculiarity which often accompanies simple or double hare-lip. The middle bone is, then, the rudiment of the incisor, or intermaxillary bone of mammiferous animals, which, by anomaly, is not united to those between which it is enclosed in the normal condition. It more commonly supports the two first incisor teeth, in the adult, causing a projection forwards, beyond the maxillary bone, the three portions never having been united; this appears dependent upon want of that pressure usually afforded by the lip.

The mucous membrane forms a fold, termed the frenum of the lip; this should always be divided before the margins of the division are refreshed in the operation for hare-lip. Without this precaution, there is great difficulty in carrying the posterior branch of the scissars sufficiently high, neither could the plate be placed between the lip and bone when the bistouri is used. Desault recommended the maxillary sinus to be penetrated through the space separating the bones from the posterior surface of the lip. Nothing is more simple than this operation, as it merely requires the mucous membrane, between the root of the canine tooth and the malar eminence, to be detached, in order to reach this cavity. We may, by the same method, expose the infra-orbital nerve, when we would excise it by the mouth. It must, however, be noticed, that, in this operation, we can scarcely avoid cutting the levator muscle; but this inconvenience is more than balanced by the advantages resulting from the absence of cicatrix in the skin, especially in females. The posterior surface of the superior lip being concave, we must, after the operation, if we would avoid a fissure posteriorly, pass the needles in such a manner that they traverse the parts at the union of the two anterior with the posterior third of the organ.

Inferior lip.—This is generally a little thicker and more everted forwards, instead of projecting in the median line. Its free border offers a depression, corresponding to the superior labial crest; this border is slightly convex at its centre portion, and as it inclines downwards on either side, cancers may be removed by a semilunar incision, having its convexity directed downwards. The fissure which results is not so much marked

as might be expected after cicatrisation; in fact, the free border of this lip need not be convex, to receive the upper one; its natural eversion is not indispensable to its functions. Although shorter, it ascends sufficiently after the operation to touch the other, as the cicatrix, in forming, draws up the skin of the throat, anterior to the chin, and thus elongates the lip. Numerous operations confirm these assertions.

The *cutaneous surface* of the lower lip presents neither crest nor vertical depressions; consequently, congenital hare-lip should occur in the median line. In uniting with that of the upper lip, its free border forms the commissures, which, being frequently the seat of excoriation, ulcers, and wounds, require particular attention, on account of the contraction which may ensue. Their wounds must necessarily be treated by suture, otherwise the motion of the lips would prevent cicatrisation, and cause great deformity.

The constituent parts are the same as those of the upper lip, differing only as to arrangement. The skin is not covered by so many hairs, merely supporting a tuft, placed on the sublabial fossa. The *cellulo-adipose tissue*, disposed as in the other lip, is, perhaps, more abundant. The *muscles* are the same, with the exception of its receiving the extremity of its *levator*, *depressor*, and *depressor anguli oris*, instead of those entering into the formation of the preceding. Its *coronary artery* separates from the facial, at a greater distance from the commissure, and in consequence of the arch, formed between this artery and its fellow of the opposite side, not giving off any vertical branch, transverse wounds in the median line do not produce hemorrhage. As it approaches the centre of the free border, it is more easily reached from above, downwards. Finally, we may recognize the exact course of this artery, by drawing a curved line, passing about three lines from the free border of the lip, and terminating anteriorly to the inferior portion of the masseter. The lower lip also receives some small branches from the *mental*, and the *superior coronary* gives off a branch, at a short distance from its commencement.

The *veins* and *lymphatics* present the same characters as those of the chin and upper lip.

Nerves.—The terminating filaments of the *inferior dental*, and some from the *buccal*, are distributed to the deeper parts. The superficial nerves appertain to the *cervico-facial* of the seventh, and to the ascending branches of the *cervical plexus*. Finally, they are less numerous than in the upper lip, and, consequently, the sensibility here is not so great.

The *mucous membrane* forms a fold, which is attached to the symphysis, but is shorter than that of the upper lip; whilst the glands separating this membrane from the lips are more numerous, larger, and their excretory ducts more distinct.

This lip lies on the inferior alveolar arch, and the externa surface of the incisor and canine teeth.

Remarks.—The attachments of the lips, posteriorly, and their greater degree of softness in this direction, account for their eversion in tumefaction. In consequence of the homogeneous nature of their texture, erysipelas commonly causes considerable swelling, suppuration produces no separation of parts, and wounds heal very promptly. As their tissues become thinner towards the mouth, abscesses commonly point in that direction. The thickness and slight adherence of their mucous membrane explains how it may be preserved, and folded like a hem on the edges of the wound, after the removal of the other tissues, according to the process of M. Dieffenbach, &c.

As the lips are primitively formed, of neither two, three, nor four pieces, but of one only, we may conceive that hare-lip, being the result of disease, and not of arrest of developement in the embryo, may occur equally in the median line as elsewhere. Their vitality, and the elasticity of the surrounding parts, allow of loss of substance being remedied by all the autoplastic measures. Finally, it is to the numerous glands, and the semi-lamellous nature of the submucous cellular tissue, that those malignant tumours observed on the free border of the internal surface of the lips, especially the superior, are owing. For these, excision is the only remedy.

SECTION SIXTH.

BUCCAL REGION, OR CAVITY.

Circumscribed, anteriorly and laterally, by the internal surface of the two alveolar arches; posteriorly, by the pharynx; superiorly, by the nasal fossæ; and, inferiorly, by the space between the borders of the inferior maxilla; the mouth forms a cavity, filled naturally by the tongue, when the jaws are closed. When the organ of speech has been removed, its vertical diameter, in the centre, is from eighteen to twenty lines, and somewhat less from before backwards.

Roof of the palate.—The upper wall of the mouth is concave, inclining forwards, and towards each side, to unite with the dental arch, being continuous, posteriorly, with the soft palate.

Its *mucous membrane*, dense, light-coloured, presenting several hard transverse ridges, especially anteriorly, softer and redder posteriorly, is covered by epidermis. The dense structure of this membrane explains why it is so rarely affected by disease; but it sometimes is the seat of very hard fibrous tumours, which occasionally attain considerable size.

The *vessels* arrive here through the posterior palatine fora-

mina. Their principal branch follows the circumference of the roof, at first between the bones and fibrous tissue, afterwards between the latter and mucous layers. Should either of the arteries become aneurismal, it would be difficult to treat it otherwise than by the actual cautery, as the inequality of the bones, and the hardness of the parts, would prevent the application either of compression or a ligature. The *veins* accompany the arteries, and the *lymphatics* pass beneath the jaw. The *nerves* all proceed from the *spheno-palatine ganglion*, but by two routes. The *superior palatine* descends with the artery, following the same track on the palate. The *naso-palatine ganglion*, situated in the anterior palatine hole, gives off a bundle of filaments, which are distributed to the palatine membrane, behind the incisor teeth.

We find, in the roof of the mouth, the palatine process of the superior maxillary, and the horizontal portion of the palate bones. By the union of these four portions a crucial suture is formed, the point of junction being in the median line, at the union of the two anterior with the posterior third. At this point, a probe, introduced into the mouth, may touch five bones at once. It is also here that syphilis so often causes caries or necrosis, producing communications between the nose and the mouth, which, notwithstanding they may be effaced by proper methods, most commonly influence the tone of the voice.

When the median suture is not completed, posteriorly, there results an anormal division of the velum palati. If this separation be prolonged, anteriorly, two circumstances may ensue. In one, which ordinarily coincides with double hare-lip, the division is bifurcated, and its branches enclose the intermaxillary bone. In the other there is no bifurcation, but the fissure extends obliquely outwards, and is accompanied by simple hare-lip. Finally, this fissure may proceed from one end of the roof to the other, without quitting the median line. All these cases, commonly the result of congenital malformation, or disease of the fœtus, are mostly accompanied by deficient developement of bone.

Another singular anomaly may also exist. In a subject brought into the dissecting room, there was no bony roof, the palatine membrane being double its natural thickness, and of the consistency of fibro-cartilage; that of the floor of the nares was in the same condition, but separated from the latter by a space of about a line and a half, filled by a kind of mucus, forming a closed cavity between the nose and mouth.

Inferior wall.—Confounded with the supra-hyoid region, the floor of the mouth presents, in the median line, the organ of speech, which nearly fills it.

Free through its whole extent, the *upper surface of the tongue* is prolonged, through the isthmus of the fauces, as far as the

epiglottis. Convex from before backwards, and from side to side, it is grooved in the median line.

Adherent at its two posterior thirds, the *inferior surface* there receives its muscles, nerves, and vessels. Its anterior third is free, or fixed merely by a fold of mucous membrane, termed *frenum*, which, by being too short, prevents infants at the breast from obtaining sufficient nourishment; whence the necessity of its division; or, on the contrary, by being too long, it has led to the fear of the tongue being turned back into the throat, producing suffocation; but if these fears are not quite chimerical, they are at least very much exaggerated.

Circumference.—The mouth here presents the internal surface of the gums, in which we find the same elements as in the roof. The texture being less compact and more vascular, accounts for the frequency of diseases here. Being continuous with the mucous membrane of the roof, the gums close, anteriorly and posteriorly, the inferior openings of the palatine canals; so that, properly speaking, these foramina only exist in the dried bones.

The *internal surface* of the teeth is, as it were, crossed anteriorly, when the mouth is closed, by a horizontal fissure, more or less developed, according as these small bodies incline towards the lips.

Posteriorly, between the anterior pillar of the fauces and the last molar tooth, there is a space capable of admitting the extremity of the little finger, corresponding, in some individuals, to the anterior border of the coronoid process, forming a communication between the buccal cavity and the labial fossa. When swollen and inflamed, the mucous membrane of the cheek and tongue becomes sometimes implicated in this aperture, and is thus injured during mastication. An instrument also might penetrate by this opening into the mouth, although the jaws were firmly closed at the time.

In some individuals we observe other small spaces between the teeth, producing that undulated condition of the circumference of the tongue perceptible when it is the seat of inflammation. Moreover, it should be remarked, that the wall of the alveoli, uniting almost immediately internally with the roof of the palate, is shorter and stronger in this situation than externally; thus, in extraction of teeth by the key, the application of the instrument to the inner side of the jaw is much less likely to fracture the alveoli than when used in the opposite direction, as the point of resistance is more solid; and, moreover, the roots of the teeth being naturally curved inwards, they are thus more easily extracted.

Remarks.—The first bicuspid tooth, corresponding to the infra-orbital and mental foramina, serves as a guide in section of the nerves emerging through these openings. The pressure of the soft parts of the face, cheeks, and of the lips in particular,

although but slightly manifest, is, nevertheless, the principal cause of the direction assumed by the teeth during their developement. Thus, they commonly project forwards in individuals affected by hare lip, or loss of substance at the circumference of the mouth; and to the same reason must be attributed the success attending compression of the sides or circumference in cases of cleft palates. The size of the tongue, also, tends to preserve the teeth in their proper direction, as they would incline inwards towards the palate, upon the loss of this organ, were it not that a superior power flattens the jaws, and contracts the buccal cavity.

The square form and tubercles of the large molar teeth enables those in the lower jaw to dovetail with those in the upper: thus guarding against displacement, in fracture of the inferior maxilla. Arrested in its developement by the border of the coronoid process, the dens sapientiæ, deviating backwards, presses against its nerve, producing the inconvenience which sometimes precedes its eruption; hence, the relief procured from the abstraction of the next tooth, by giving it room to develope.

From the insensible elevation of the alveolar border, towards the coronoid process, the gum surrounding, not only the next, but the crown of the last tooth, cannot swell, without being prolonged forwards, extending between the two jaws, giving rise to ulceration, and the intense pain attendant on its inflammations. The dental edge of the gums, although sufficiently firm to increase the solidity of the teeth, being merely a layer surrounding their neck, scarcely ever inflames, without separating from them. Thus, caustics, or other local applications, should be carefully applied, on the internal surface, and not to the edge, or free surface.

The solidity of the gums causing, with regard to all the teeth, the same opposition experienced by the wisdom tooth from the coronoid process, accounts for the extreme pain attending first dentition, and the relief experienced from lancing the gums. It also shows why caries of the teeth is so frequently accompanied by swelling of the whole face, and abscesses at the bottom of the alveolo facial fossa, where the tissues are most lax.

As the teeth receive their nerves from the fifth pair, which also supply the eye, their diseases sometimes produce amaurosis. Opened into the mouth by caries, different foreign bodies may lodge in them, and thus become the origin of symptoms, the cause of which it would otherwise be difficult to understand. In one case, which had been under treatment for about two years, the patient, who was amaurotic, had a carious tooth extracted, in which was found the root of some herb; after this he promptly recovered. Their nerves being also distributed to

the whole of the head, a diseased tooth is often the unsuspected cause of headaches, neuralgia of the face, erysipelas, &c.

Of the tongue.—Attached to the os hyoides, which participates in most of its motions, the tongue, uniting the functions of speech, deglutition, and respiration, is worthy of some consideration.

Papillæ.—Its dorsal surface, enveloped in a thick membrane, is covered by numerous papillæ; these posteriorly large, flattened, present a depression in their centre, and are the organs of secretion, uniting round the excavation termed *feramen cæcum.* In the middle, as also at its apex and sides, where the membrane is much finer, they are, on the contrary, *conical* or *fungiform*, small, erectile, forming the organs of sensation; they require the closest examination in acute diseases, and are not unimportant in chronic affections. Although their colour and prominence vary ad infinitum, in the various derangements of health, we can say, that in general, when they are pale, and slightly developed, when the tongue is clean, or more or less charged, the organs of digestion, and in particular the stomach, would bear, without danger, evacuant or stimulating medicines; whilst, if they are red, raised from the mucous membrane, if they appear stretched, we should be cautious in administering such remedies. On account of the dense texture, and elasticity of this membrane, it is frequently cracked, and tumours are generally hard, and of small volume.

The membrane of the posterior part of the tongue is thin, forming three folds; two on the sides, enveloping the anterior pillars of the fauces; the other, on the median line, uniting the tongue to the epiglottis. On its inferior surface, it is elastic, thin, slightly adherent, and of a brownish colour, derived from the vessels which it immediately covers. Reflected on the floor of the mouth, this membrane forms a kind of fringed crest, containing some adipose vesicles. Where this crest unites with that of the opposite side, we find the orifice of the whartonian duct close to the frenum; the ducts of the sub-lingual gland open rather more posteriorly.

The proper structure of the tongue is composed of delicately interwoven fibres, the major part of which are directed from before backwards; thus, incisions should be made in this direction, and cancerous tumours of its apex removed, in a triangular flap, having its base forwards. These fibres are furnished by the *lingualis*, *genio-glossus*, *hyo-glossus*, and *stylo-glossus* muscles; and, having their fixed point backwards and downwards, they, in a great degree, prevent the tongue from being drawn forwards during operations. It has, therefore, been my custom, under these circumstances, to pass a ligature through the organ, and thus remove the impediment.

The *tongue* encloses numerous *arteries*, derived from the ex-

ternal carotid. Of these, the only branches deserving attention are, the *dorsal*, the *inferior palatine*, distributed to the surrounding parts or to the tonsils, and the *ranine*. Placed on the inferior surface, at its commencement between the hyo-glossus, genio-glossus, and lingualis muscles, which render it deeply seated posteriorly, this latter becomes very superficial as it approaches the apex, where it is covered merely by mucous membrane. Thus, in division of the frenum, the points of the scissors should be directed downwards from the tongue. Its tortuous course, the softness and mobility of its investing tissues causing it to retract considerably after its division, render it difficult to be secured; and, moreover, as the natural moisture opposes the astringent action of the air on the divided parts, the actual cautery, compression with forceps, or torsion, are the only remedies which can be adopted.

More numerous, and larger than the arteries, the *veins* communicate directly with those of the amygdalæ and pharynx. Forming a plexus, remarked principally on the inferior surface, they, by uniting at its free portion, produce the ranine vein, which, situated external to and more superficially than the artery, is of sufficient size to be beneficially opened in diseases of the mouth or tongue. To effect this, the point of the lancet should be directed obliquely, backwards, upwards, and outwards. This disposition also indicates the superiority, in swelling of the tongue, of incisions made on the sides of its inferior over those on its dorsal surface. It may, however, be observed, that the quantity of blood following these incisions is not always sufficient to account for the instantaneous relief which they produce.

The different points of the buccal surface of the tongue are not equally endowed with taste. MM. Guyot and Admyroult have demonstrated that this is confined to the apex and sides; consequently, diseases, and operations, when situated at the base or centre of its upper or lower surfaces, do not interfere with this function.

Interwoven, as it were, like a sponge among the other elements, the *cellular tissue* accounts for the rapid enlargement of the tongue, and the success of compression, when employed in reducing this organ, after it has remained for a long period out of its natural cavity. As the muscles adhere equally at all points, wounds have but little tendency to separate, more especially as the swelling of the organ promotes adhesion, by approximating the edges.

The *lymphatics* pass into the sub-maxillary and cervical glands.

The *nerves* are derived from three branches: the *glosso-pharyngeal* belongs principally to the base, and its filaments may be traced into the lenticular papillæ; the *lingual* branch of the fifth, ramifying freely in the muscular fibres, terminates

in the coniform and fungiform papillæ; whilst the *hypo-glossal* is lost in the muscles. This latter has long been considered the nerve of motion, whilst the other two supply taste and sensation. This difference of function is the reason of the varying effects of paralysis. In some persons, the organ of taste is destroyed, though the motion of the tongue remains, whilst in others, the contrary takes place. The tongue is also supplied by numerous branches of the great sympathetic.

In man, this organ has no *skeleton*, but encloses, in the median line, a fibrous septum, placed edgewise, which is prolonged, backwards, towards the epiglottis, giving attachment to the muscular fibres. Forming its solid portion, it divides the tongue into halves, either of which may swell, or become paralysed, independent of the other.

Beneath the mucous membrane, between the tongue and the lower jaw, are situated the sub-lingual gland, anteriorly, and a process of the sub-maxillary, posteriorly. It must be remarked, that the lymphatic glands, becoming swollen, may be mistaken for disease of the salivary glands. When the former become affected with cancer, or any other disease requiring extirpation, we should commence detaching them from the bone, by raising them with a tenaculum; after which, they may be removed with facility, and comparatively little risk, if the knife is directed from the ranine and sub-lingual arteries.

When the canal of the latter becomes so much dilated as to produce ranula, it pushes the tongue upwards, and may contract the isthmus of the fauces to such an extent as to produce symptoms of suffocation. As these tumours, in enlarging, separate from the vessels and nerves, a large portion of their wall may be removed without danger.

Isthmus of the fauces.—The pharyngeal opening of the mouth is formed, below, by the root of the tongue; above, by the velum palati; laterally, by the pillars of the fauces.

Prolonged from the soft tissues of the roof of the mouth, and floor of the nasal fossæ, the *velum palati* also encloses a certain number of muscles. Its mucous layer, thick, inelastic, easily torn, and of a deeper colour than that of the mouth, is invested with a dense filamentous tissue, possessing very large follicles. This latter is united to the muscles by cellular tissue, and it is in its substance that purulent and œdematous infiltrations occur. Its vessels and nerves are of no importance in a surgical point. The abundance of its venous capillaries accounts for the prompt and advantageous results obtained from the application of nitre of silver, or alum, in certain inflammations.

The *muscles* of the palate are, the *levator palati*, which raises the velum towards the nasal fossa; the *circumflexus palati*, which stretches it horizontally; the *palato glossus*, and *palato pharangeus*, which draw it downwards towards the base of the tongue; finally, the *azygos uvulæ*, which belongs especially to the *uvula*.

As these muscles are situated on each side, the separation which occurs, when this organ is divided, is easily understood; but not so the spontaneous closing of wounds in some of the convulsive movements of the pharynx; for instance, when, in a young boy I made a vertical incision through the whole of this portion, in order to remove a large polypus, the lips of the wound, instead of separating, united, commencing at the uvula. The recognized laws of muscular contraction do not satisfactorily explain this phenomenon. Whether the velum, like the roof of the palate, be, or be not, formed by the approximation of the two lateral parts, this union, if incomplete, leaves a congenital division, which may exist alone, or be accompanied by more or less division of the palatine suture; in some instances so prolonged, anteriorly, as to be complicated with simple or double hare-lip.

Uvula.—The free border of the velum palati is prolonged, in the centre, by a conical eminence, the length of which varies considerably; this small body, attached to the posterior nasal spine, is termed the uvula; its form depending on that of the azygos uvulæ muscle, which causes its retraction and elevation. It is composed, in a great degree, of mucous membrane. Indeed, this, with the addition of follicles, forms the whole of the inferior half of its free portion. Its crypts are so large and numerous, that they form a thick layer, giving the uvula a very distinct glandular appearance. When these swell, when the cellular tissue inflames, and infiltration occurs in the mucous membrane, what is termed relaxation of the uvula results. Whatever may be the cause of this elongation, it may, without being very great, produce much inconvenience and cough, by irritating the fauces, so much so, that several practitioners have mistaken this for phthisis, and have published cures of this latter disease, effected by excision of the uvula. It may be removed, to a great extent, without causing inconvenience, as its destruction by ulceration daily proves.

Pillars.—On either side of the uvula is an arch, which, bifurcating, forms the pillars of the fauces, thus constituting the lateral portions of the isthmus. The *anterior pillar*, or branch, encloses the *palato glossus* muscle, terminating at the side of the tongue. The *posterior*, containing the *palato pharyngeus* muscle, extends to the side of the pharynx, and appears to become attached to the body of the os hyoides.

The *amygdalæ*, or *tonsils.*—Placed between the pillars, composed of numerous crypts, between which the mucous membrane, adhering firmly, is reflected, the tonsils may be inflamed, either on their surface, or in the interstices between the crypts.

In the former case, the inflammation ordinarily produces false membranes, which have frequently been mistaken for ulceration, and even gangrene. When the inflammatory phenomena occur in the interfollicular and submucous cellular tissue, they tend to the formation of abscess, and constitute a species of phlegmon,

which should not be confounded with that of the surrounding cellular tissue, which will be considered hereafter. A frequent recurrence of this affection often causes induration of the organ, and, in either case, the knife may sometimes be very serviceable.

The relations of the tonsil, especially in its external portion, should be studied with precision. In the latter situation, it is close to the internal carotid artery, from which it is only separated by the constrictor of the pharynx, cellular tissue, nervous filaments, and a plexus of veins. As the artery, in general, lies from eight to ten lines posterior, and external to the glands, a bistouri, plunged between the pillars of the fauces, would be likely to injure it, especially as, in swelling, the tonsil becomes much closer to it. To avoid so serious an accident, we should direct the point of the instrument towards the pharynx, rather than the ramus of the jaw. Although Burns has reported one example, Portal a second, Beclard a third, and Barclay a fourth, this accident is, nevertheless, very unfrequent. In extirpation of the indurated gland, there is still less risk, as, the organ being fixed and drawn inwards by a tenaculum, it is scarcely possible, by cutting with scissors or bistouri, to injure the artery. The *tonsillitóme*, a kind of ring, one blade of which slides upon the other, may be used with still less danger, as it can only divide the projecting portion of the diseased body. The hemorrhage which succeeds this operation, considerable in some cases, proceeds from the superior and inferior palatine arches, from numerous large veins, and from a plexus, situated externally to the posterior wall of the pharynx. Notwithstanding the tonsils cannot be extirpated without danger, we should not entirely reject this operation, as I demonstrated the possibility of its performance, in 1835, on a patient who had a cancerous mass in his pharynx, larger than a duck's egg. It is in the depressions lodging in the tonsils, and on the surface of the tonsils themselves, that syphilitic ulcers of the fauces are most frequently developed, and that the formations of croup commence, in the majority of cases; they should, consequently, be examined with the greatest attention, when such diseases are suspected.

Their mucous membrane, being folded several times upon itself, the tonsils are subject to all diseases common to this class of membranes, and the more so, as their numerous irregularities retain the different causes of irritation, whether general or specific. Thus it is that the nitrate of silver, alum, &c., applied locally, produce such beneficial results. The structure, forming the centre of their folds, being elastic and vascular, explains the nature of their abscesses, and the manner in which they open. The tissue, in the middle of which they are prolonged, by their external portion, much more elastic, and continuous with the cellular tissue of the neck, accounts for the extension of intense and deep-seated inflammation into the supra-hyoid region, or even above the clavicle, there producing large abscesses. Being

unable to extend outwards, in consequence of the jaw, and the various aponeuroses, they approach each other, in swelling, so as to contract the isthmus of the fauces, the nares, the eustachian tube, and the entrance of the larynx; producing deafness, and difficulty of respiration, and deglutition. In consequence of their mobility, they are easily disengaged from the excavation in which they are naturally placed, and the two pillars of the fauces serving as support to the instrument, it is better, in removing them, to use a simple tenaculum, and a probe-pointed bistouri, applied in a sawing manner, from below, upwards, than to have recourse to scissors.

SECTION SEVENTH.

THE PHARYNGEAL REGION.

Larger in its centre than at its extremities, the pharynx appears formed of two cones, united by their bases, the superior of which is curved forwards, to be continuous with the nasal fossæ, whilst the inferior descends nearly perpendicularly. The *anterior portion* is the most complicated.

The *posterior opening of the nares*, the superior and inferior wall of which incline downwards, forming a curve, and not a right angle, is the cause of the facility with which substances, coming from the stomach, enter the nose, when the velum palati is lowered or destroyed, and reciprocally of sounds, and other foreign bodies, descending easily into the pharynx, after traversing the nasal fossæ. And as the posterior surface of the velum palati and uvula are prolonged for an inch and half behind the roof of the palate, any thing passing from the nasal fossæ into the fauces, falls posterior to the larynx, and is separated, by these means, from the respiratory organs; and, accordingly, sounds and other tubes are with difficulty introduced into the glottis, through the nose, whilst the stomach is more surely reached by that route, than by the mouth.

The *buccal opening* extends very obliquely, downwards, into the pharynx, which it appears to prolong, upwards and forwards. In consequence of this arrangement, the food, collected into a mass on the base of the tongue, descends, by its own weight, into the pharynx, unless prevented by the isthmus of the fauces; and, in vomiting, the contents of the stomach, are ejected through it, rather than by the nose.

The posterior surface of the larynx, and its epiglottideal opening, being next in order, present, in the median line, the prominence corresponding to the cricoid and arytenoid cartilages; a prominence more marked, but narrower superiorly than inferiorly. On the sides are distinguishable two grooves, very deep, especially towards the mouth, where they are lost, having

passed external to the epiglottis. These fossæ, with the eminence, naturally divide the fluids, entering the pharynx, into two columns, thus preventing their flowing into the larynx, even when the epiglottis does not exist. The whole is circumscribed, laterally, by the internal surface of the thyroid cartilage, invested by its villous membrane.

The *laryngeal opening* is a fissure extending ten lines from before, backwards, and from one and a half to three lines transversely, larger at its posterior than anterior extremity, which is more raised, looking upwards, and slightly backwards, and surmounted by the epiglottis, forming a kind of valve, attached to the larynx by a pedicle, in the retiring angle of the thyroid cartilage, and laterally by the aryteno epiglottidean. The position of this cartilage is such, that it in reality only closes the wind-pipe during deglutition, or when it is necessary to retain a large quantity of air in the lungs, as in carrying heavy loads, &c. But it must also be added, with M. Bourdon, that, in this case, the obliteration of the larynx is caused more by the approximation of the cordæ vocalis, than by the abasement of the epiglottis. At other times, the epiglottis is raised almost perpendicularly, its anterior surface looking towards the superior dental arch, whilst the posterior is turned towards the back of the pharynx. Thus, when we would introduce a tube into the glottis of new-born infants, when it is vertical and very small, or of patients suffering from asphyxia, we should depress the tongue, and pass the tube by the side of the fauces; as thus we enter into the laryngeal fossæ, and the end of the tube being curved inwards, it enters the glottis, when directed towards the tongue. It may also be remarked, that this operation is more easily performed through the mouth than through the nose, as by the latter the instrument strikes against the back of the pharynx, and is with difficulty conducted into the windpipe, without the assistance of a finger introduced deeply into the throat.

The *posterior wall* of the pharynx presents but few points of importance; the mucous membrane is very thick, especially upwards, and encloses several very large follicles, predisposing it to ulceration and inflammation, which often occur here, and covering it with inequalities, occasionally mistaken for morbid alterations, when they do not exist. Separated from the atlas, and dentator, by the recti muscles of the head, and by a certain quantity of loose cellular tissue, in which abscesses frequently occur, it is naturally exposed to various alterations, and even perforations, by collections and various tumours resulting from affections of the spinal marrow in the cervical region. It is separated from the bodies of the vertebræ, in the median line, by the vertebral ligament, and by the rectus anticus major, or longus colli muscles, from the transverse processes. There are, consequently, no organs of importance likely to be wounded in

operations at this spot. Jugglers are hence enabled to introduce swords, &c. with impunity into the fauces, the extremity of the metal being applied upon the anterior surface of the vertebræ, the instrument is maintained in its equilibrium by the jaws.

The union of the posterior wall of the pharynx, with the above-mentioned organs, takes place by means of loose and very elastic cellular tissue, in which one of the branches of the inferior pharyngeal arteries ramifies; also several large veins, which separate and reunite several times, forming a plexus, the trunks of which empty into the internal jugular vein. In addition to these, we meet with filaments of the glosso-pharyngeal, pneumogastric, and great sympathetic nerves.

The eustachian tube is situated at the superior portion of the sides of the pharynx. It consists of a species of funnel, enclosing a fibro cartilage, forming the two thirds or three fourths of a canal, completed by mucous membrane, which not only invests its free portion, but is prolonged, through its interior, into the ear itself. This canal is placed at some lines posterior to the middle meatus of the nose, with its opening looking upwards and backwards. There is a depression between the root of the pterygoid and the basilar process, by which a sound may be introduced through the middle meatus, if, arriving at the pharynx, the points of the instruments be very slightly raised.

By the inferior meatus, all that is necessary to be observed is, to raise the point of the instrument slightly outwards, when it will of itself slide into the required point.

The levator palati muscle descending to the velum, represents an oblique column from above, downwards and forwards, which, with the pterygoid process, and the circumflexus palati, circumscribes a triangular space, having its base directed downwards, containing the eustachian tube, and into which a sound is introduced, without difficulty, along the floor of the nares; if the instrument be then carried upwards, it enters directly into the tube, provided it does not pass beyond the fleshy pillar; and, moreover, the operation is rendered exceedingly simple, by the mucous membrane enveloping the inferior cornua, passing directly to the superior portion of this tube. Finally, as this canal is directed outwards, backwards, and slightly upwards, when we would penetrate it we should have the instruments slightly curved, and, as there is some risk in using solid metallic sounds, from their liability to bruise the parts, a soft gum elastic catheter should always be used.

The posterior pillar of the velum forms a second column, descending backwards and outwards to the side of the pharynx. Inferiorly, this wall becomes gradually contracted, and presents nothing worthy of notice; but opposite the parotid region it corresponds to the primitive carotid below; a little higher, to

the internal and external carotids; and, in its whole extent, to the jugular vein, which, lying on the external surface of the arteries, is placed quite posteriorly, and slightly outwards, as it emerges from the cranium, through the posterior lacerated foramen; to the glosso-pharyngeal nerve, which is in a great measure distributed in it; to the superior cervical ganglion, its numerous filaments and eighth pair of nerves lying behind and between the vessels; also, to the spinal accessory nerve, but only at its superior portion; finally, to the lingual nerve; and, more remotely, to the styloid process, its muscles, and the parotid gland. These relations sufficiently indicate the danger attending wounds of this region.

The superior extremity of the pharynx is formed by its posterior wall inclining forwards towards the nares. The mucous membrane is softer, thicker, and redder here than in the rest of the organ. The superior constrictor muscle, attached to the basilar process, close to the sphenoid bone, being separated from the foramen magnum for more than an inch by the anterior recti muscles, pushes the velum palati when it ascends towards the roof of the pharynx, thus closing the nasal fossæ in deglutition, vomiting, &c. The *skeleton* above the soft parts belongs to the base of the cranium, and is composed of the basilar process, and of a portion of the occipito-petrosal suture. The principal bone being very thick, the brain is here well protected. The vascularity of these bones explains the predilection of sanguineous polypi, sarcoma, and fibrous tumours for the roof of the pharynx. Cancerous vegetations of the dura mater, and syphilitic productions, are not so easily accounted for.

Between the occipital bone and anterior arch of the atlas there is a considerable space, filled merely by ligaments; thus, an instrument plunged upwards and backwards, through the mouth, may, without difficulty, penetrate the spinal canal or cranium, and divide the medulla oblongata.

The *inferior extremity of the pharynx* contracts considerably at its union with the œsophagus, opposite the cricoid cartilage. In consequence of this constriction, foreign substances, of any magnitude, frequently lodge in it. It must also be remarked, that the tissues composing the pharynx become here altered in character. The internal membrane, red and filled with follicles in the cavity which we have examined, becomes here suddenly pale, and nearly smooth; the transverse muscular fibres suddenly assume a vertical direction, and the pharyngeal canal then becomes distinct from the larynx.

SECTION EIGHTH.

THE JAW.

The jaw, limited by the parotid, orbital, nasal, labial, and mental regons, comprehends the masseteric and zygomatic eminences, and the genal and canine fossæ.

Zygomatic region.

This region comprehends all the parts composing the cheek, which eminence is more or less acute, or rounded, according to the race, age, and sex of individuals. Internally, and inferiorly, we observe, in most subjects, an oblique depression, extending from the internal angle of the eye to the genal region, separating the canine fossa from the malar eminence. This is the *naso-jugal* depression, which M. Jadelot named *oculo-zygomatic tract*, considering it as indicative of the diseases of the cerebro-spinal system, in infants. Another depression, oblique, in the same direction, extends from the ala nasi to the angle of the lips. This is the *naso-labial* depression, separating the labial region from that which we are now examining, and being much more regular than the preceding. M. Jadelot ascribes this tract, which he terms nasal, to affections of the abdominal organs.

The *skin* of the cheek is smooth, delicate, and more coloured than in other parts of the face. It is here that the hectic blush in pulmonic inflammation, and the yellow or livid tint in diseases of the liver, and in internal suppuration, appear. Inferiorly, and externally, in the male, it is covered by hair.

The *cellulo-adipose tissue* forms a layer, of greater or less thickness, according as it corresponds to the muscles or their interstices. On the malar eminence, where it is dense and filamentous, the skin adheres so intimately that in operations it should be preserved as much as possible. Yielding but little to adhesive remedies, wounds but seldom unite by first intention. Internally and inferiorly, the cellular layer is thin. Its fatty vesicles are small, and few in number; and uniting, intimately, to the skin and elevator muscles of the upper lip, it renders inflammations exceedingly painful, and gives them the character rather of erysipelas than of phlegmon. In the canine fossæ, its lamellæ are looser, and its fatty vesicles more abundant; passing between the muscles, they fill the osseous cavity, communicate with those of the genal region, and thus envelope the whole of the nerves and vessels. It is, therefore, more easy to cure wounds, by first intention here, than over the malar eminence, and for the same reason inflammation is more frequent, and most commonly terminates in abscess.

Proceeding from the nose towards the malar eminence, we find the *levator labii superioris*, and the two *zygomatic* muscles,

converging as they descend, and adhering to the skin, from which they are separated by cellular tissue. Behind the former, and, consequently, more deeply seated, is the *compressor nasi*, hidden by the common elevator, and the *levator anguli oris* muscle, which, partly covering the *proper elevator*, and, sometimes, a small portion of the *zygomatic*, is united to the internal membrane of the lip by very dense and thin tissue. Between the fibres of the *orbicularis palpebrarum*, the proper elevator and zygomatic muscles, there commonly exists a space, filled by cellulo-adipose tissue, vessels, and nerves. This space corresponds to the canine fossa.

Arteries.—The *infra-orbital* lies in the canine fossa, at a distance of three lines from the inferior orbital arch, opposite to the centre of a line drawn from the inferior border of the nasal bone to the lower portion of the malar eminence, behind the proper elevator, corresponding to its external border, anterior, and above the levator anguli oris muscle. The nerves and cellular tissue separate it from the bone, and the facial vein with fat, from the orbicular muscle.

The *transverse facial artery*, passing beneath the jugal eminence, is sometimes of sufficient size to cause hemorrhage; but the tissue in which it ramifies is so loose that it may easily be secured by ligature. The facial artery, in traversing the levator anguli oris and the elevator muscles, behind the naso-labial depression, commonly runs along the internal and inferior boundaries of this region; from this point it proceeds to the internal angle of the eye, anastomosing with the ophthalmic, after it has assumed the name of *angular*, sometimes being of considerable size.

Among the *veins*, one only deserves attention, and that is the *facial*. Not accompanying the arteries, which are, for the most part, without collateral veins, this vessel appears to be the continuation of the frontal. Nearly at its commencement it communicates with the veins of the orbit. Anterior to the masseter muscle, covered by the inferior fibres of the orbicularis palpebrarum muscle, enveloped, inferiorly, in cellulo-adipose tissue, separating the zygomatic from the levator anguli and buccinator muscles, this vein is crossed in front by the ramifications of the facial nerve, and, behind, by the buccal and infra-orbital.

The *lymphatics* are few in number, and pass to the submaxillary gland, there being no known glands in this region.

We here find the termination of the *superior maxillary* or *infra-orbital nerve*, the branches of which supply the skin of the lips, nose, nasal eminence, and inferior orbital arch, where they anastomose with branches from the facial.

When, in tic-doloreux, it is necessary to divide this nerve, the operation is easily performed by cutting on the naso-jugal depression, between the naso-palpebral and proper elevator of the lip, and turning the facial vein outwards, and the levator muscle

inwards. The skin and cellular tissue being thus divided, the nerve is found close to the origin of the levator anguli muscle. This method appears more simple than that of M. Langenbeck.

The zygomato-maxillary region next receives the nerves proceeding from the facial, which are enveloped in the subcutaneous tissue, before they are lost in the muscles. The experiments of Shaw and Sir Charles Bell have proved that the actions of the muscles are here under the influence of the facial nerve, whilst the infra-orbital endows the parts with sensation. There are also some filaments, proceeding from the lachrymal, on the malar bone, but they only serve to explain some of the sympathetic pains affecting this region.

Skeleton.—The malar bone, notwithstanding its solidity, is exposed to fracture, from its superficial position, especially externally, where it is no longer supported by the maxilla. The two zygomatic muscles are attached to it. More superiorly, and posteriorly, it is covered merely by dense cellular tissue, the malar branches of the facial nerves, and ramifications of the facial artery and lachrymal nerve, and also of the transversalis faciei artery.

The bone of the jaw represents the whole of the anterior wall of the maxillary sinus, which may be much more easily penetrated, by following the course recommended for the division of the infra-orbital nerve, than by operating, like Lamorier, on the crest, separating the canine fossa from the malar tuberosity. The wall of the sinus is so thin and brittle, that it is easily fractured and broken down, in which case the anterior dental nerves, furnished by the infra-orbital, are either stretched or torn; it is, consequently, penetrated by sharp instruments with great facility, which, plunged with violence upwards, and backwards, may pass through the floor of the orbit, the soft parts contained therein, and enter the cranium through the vault. The position of this sinus thus admits of its polypi projecting on the face. Its periosteum, not being very dense, is easily separated from the bone by inflammation, causing the necrosis and caries, which so frequently accompany diseases of the teeth. Although very thin, this wall of the sinus is frequently the seat of large cysts, filled with viscid matter, which break down, producing a sound similar to the tearing of parchment. The roots, and occasionally the bodies, of some of the teeth, are sometimes found in these tumours, which are easily mistaken for dropsy of the sinus itself.

Genal region.—Wedged, as it were, between the mental, labial, zygomato-maxillary, masseteric, and sub-maxillary regions, the limits of the genal are merely arbitrary. Its importance, in surgery, is relative to salivary fistulæ, and the course of the facial artery. It sometimes forms a considerable prominence, at others a distinct depression. In certain individuals there are dimples in this situation, depending upon muscular contraction.

Fine and smooth in women and children, the *skin* is covered by the beard in man. Although it does not adhere very intimately to the subjacent tissues, it moves less freely upon them than in the masseteric region.

The *cellulo-adipose tissue* forms a considerable mass, anterior to the masseter muscle, between the integuments and buccinator. Continuous, posteriorly, with that of the temporal fossa, it accounts for the spreading of abscesses from one of these regions to the other. When absent, in thin individuals, hollowness of the cheeks results. Its cellules diminish inferiorly and anteriorly, terminating by uniting intimately to the muscles and skin. Dense or loose, according to the quantity of fat covering the buccinator muscle, it varies but little, excepting as regards its lamellæ, which are more or less separated, depending on the size of the adipose vesicles. The masseteric aponeurosis appears to arise from this.

Muscles.—The facial portion of the platisma frequently forms a triangular fasciculus, the base at the masseter, and the apex at the angle of the lips. This muscle (*risorius santorini*), sometimes very strong, forms the dimples described above, and is situated between the laminæ of the subcutaneous cellular tissue. Inferiorly, is the *depressor anguli oris*, separated from the skin by the platisma, its fibres converging towards the angle of the mouth.

The *buccinator* is the principal muscle; separated from the skin, posteriorly, by fat and the *risorius* muscle, it nearly touches it in front. Its external surface is covered by a fibrous expansion, given off by the parotid duct, before traversing it, and which, becoming confounded with the *pterygo-maxillary aponeurosis*, is attached to the base of the coronoid and external ala of the pterygoid processes. An instrument penetrating between this aponeurosis, which lies internally, and the masseter and coronoid process, may injure the maxillary artery, inferior maxillary nerve, the carotid and internal jugular, the pneumogastric, great sympathetic nerves, &c. The buccinator, internally, is divided from the membrane of the mouth by dense and thin cellular membrane, in which are found glands, each possessing its excretory duct. In operating at this point, we should remember that the fibres of the muscle are nearly horizontal.

Steno's duct, accompanied by a branch of the facial nerve, terminates, by piercing the buccinator muscle, at four or five lines anterior to the masseter. As the distance separating it from the malar prominence is also above four lines, the process of Deguyse, for salivary fistulæ, is not so simple as might be imagined. The wall of this duct thickens, in a remarkable manner, in the genal region, considerably increasing its size. Divested of its fibrous envelope, derived from the parotid aponeurosis, it is thinner among the fleshy fibres, than before entering them. Its internal opening is at four or five lines below

the point where the mucous membrane is attached to the gums, generally opposite the last molar tooth. From the masseter muscle to its orifice, it represents an arch, the convexity looking outwards; hence the utility of everting the anterior of the cheek, with the thumb introduced into the mouth, whilst, with one or two fingers, we force inwards the portion corresponding to the muscle, as recommended by Louis, when we would pass a probe, &c. It is, in fact, this curve, together with the softness of the organ, which opposes the entrance of instruments, and not its valve, which is most commonly wanting.

Arteries.—The *facial*, entering this region beneath its posterior boundary, that is to say, anterior to the masseter muscle, lying on the maxilla, behind the triangular muscle, separated from the skin by cellular tissue, and fibres of the platisma, may be compressed or tied with facility and certainty, in operations of the face.

In order to expose it, if the masseter is not particularly distinct through the skin, it is sufficient to remark, that, proceeding from the angle of the jaw, we soon meet with a superficial groove, in which it is always situated, except in very rare cases. From this point the artery, in a serpentine direction, follows the posterior fibres of the triangularis muscle, which it crosses, to arrive at the zygomato-maxillary region. In the genal region, also, when it gives off the inferior coronary, it furnishes numerous branches, which, anastomosing, posteriorly, with the *transverse facial*, anteriorly, with the *mental*, superiorly, with the *infra-orbital;* terminate partly in this region, as does the *buccal branch*, derived from the internal maxillary.

Veins.—In the zygomato-maxillary region, the facial vein lies at some distance from the artery. Traversing the genal region, it re-approaches; finally, overlapping it, as it passes into the supra-hyoid region. This want of similarity between the two principal vessels of the face, depends upon the straightness of the vein, whilst the artery is very tortuous. Notwithstanding the size of the former, it would be dangerous to perform phlebotomy upon it, in consequence of the neighbourhood of the latter.

The *lymphatics*, like those in the upper part of the face, pass to the submaxillary glands. We also find some, more deeply seated, proceeding to the glands beneath the sterno-mastoid muscle.

The *proper nerve* of this region spreads out in the buccinator muscle, and, for this reason, receives the name of *buccal.* The others are, anteriorly and superiorly, terminating branches of the mental or infra-orbital, and, posteriorly, filaments of the facial. A considerable branch of the latter accompanies the superior border of the parotid canal.

The *mucous membrane* of the cheek is continuous with that of Steno's duct. For this reason, the parotids sometimes inflame,

in consequence of diseases of the mouth. Reflected over the alveolar arches, it becomes hard, thick, and forms the external portion of the gums. We there distinguish neither follicles nor villi, but, in the remainder of the region, it is covered by a very distinct epidermis.

The *skeleton* encloses the portion of the inferior maxillary bone, comprised between the coronoid process and mental foramen, also the external surface of the dental arches, as far as the canine tooth. We may remark, that when the inferior maxilla is fractured in this region, the elevator muscles, fixed on the posterior portion, keep it firm against the upper jaw, whilst the anterior is drawn downwards, by the depressors, attached to the os hyoides.

General remarks.—Taken as a whole, the cheek is an irregular region, the prominent portions of which, in some degree, protect the excavations. Thus, in blows or injuries of any kind, the malar eminence, the maxillary angle, and the masseter, are the parts most frequently implicated. The multiplicity of its arteries gives rise to considerable hemorrhage in operations, but as they are easily compressed, and of small size, this is rarely attended with danger. Its skin adhering too intimately to the malar prominence, lips, and chin, to allow of its stretching, explains why deposits so much more frequently occur in its central masseteric portion. Pointed instruments may enter the mouth through the genal region, and penetrate as far as the pharynx. The points to be observed in operations are, *Steno's duct*, the *facial artery*, and the direction of the muscle.

Masseteric region.—Limited by the borders and attachments of the masseter muscle, this region, in most individuals, forms a prominence, varying according to the size of the parotid gland, the masseter, and especially the developement of the maxillary angle. Having the vertical portion of the jaw as a centre, it naturally passes into the pterygoid region.

Thicker than in the parotid and genal regions, the *skin* is less dense, and more elastic. Covered in man by the whiskers, it also encloses cetaceous follicles, and allows subjacent tumours to attain a considerable degree of developement; its wounds, with loss of substance, unite, by first intention, almost as readily as in the limbs.

The *subcutaneous layer*, commonly thin, composed of lamellous tissue, blended with the fascia of the parotid and supra-hyoid regions, gives a sheath to Steno's duct, envelopes the superficial vessels and nerves, and is lost, anteriorly, in the genal region. It may be divided into two layers; one, cellulo-adipose, immediately subcutaneous; the other, thicker, lying over the masseter muscle, in the form of an aponeurosis. Union, therefore, is much more easily produced here than in other parts of the face. Tumours and abscesses, forming beneath the second layer, remain for some time flattened, and spread considerably, before

they raise the skin; whilst the filamentous character of the first layer allows of their being circumscribed, and quickly pointing externally.

Muscles.—When the mouth is moderately open, the masseter cannot effect luxation of the jaw, as it is only at the moment when the condyle passes into the zygomatic fossa, that the posterior fibres of this muscle can draw the angle of the jaw upwards, and thus produce depression of the chin. The great quantity of fibrous tissue, entering into its formation, explains the frequency of its rheumatic attacks. Being parallel to the axis of the body, and covered by no vessel of importance, incisions should be made as perpendicularly as possible, avoiding the parotid duct, which crosses it, superiorly.

The *external carotid* and *facial arteries* supply the superficial, and the *internal maxillary*, the deep branches. The *transverse facial*, proceeding from the former, crosses the muscle, enveloped in aponeurosis, at four or five lines beneath the zygomatic arch, and one or two above the parotid canal, running into the zygomato-maxillary and genal regions. Inferiorly and anteriorly, it anastomoses with the branches given off by the facial, in its passage, anterior to the masseter. In some subjects we find one or more additional transverse facial arteries, beneath Steno's duct, but rarely of sufficient size to merit any particular attention in operations. The *masseteric*, arriving at the muscle, through the sygmoid notch, anterior to the condyle, posterior to the tendon of the temporal, and above the external pterygoid muscle, may be compressed, or torn, in luxation, or fractures of the condyle.

The *veins* are of but little importance; some accompany the arteries, others are isolated. The means of communication are between the facial and external jugular; they most commonly empty themselves into the latter.

More abundant here than in any other part of the face, the *lymphatics* of this region pass into the submaxillary and parotid glands; whence rapid enlargement of these latter, in some diseases of the face.

Nerves.—The nerve, furnished by the inferior maxillary, follows the masseteric artery, and is lost in the masseter muscle. The others are, the *temporo* and *cervico facial*, branches of the seventh; the former produces a complete plexus in the aponeurosis, above and beneath Steno's duct and transverse facial artery. The filaments of the second being less numerous, wounds are not so dangerous below as at the upper part of this region.

Emerging from the parotid, *Steno's duct* immediately crosses the masseter. We have already seen, that it derives a sheath from the aponeurosis. Covered by nerves, the largest of which pass above, its superior border is also accompanied by the transverse facial artery. It is situated at eight or nine lines beneath

the zygomatic arch, posteriorly, and only three or four anteriorly. Between it and this arch there sometimes exists a particular glandular lobule; this is the *accessory of the parotid gland.* More or less superficial, according to the en-bon-point of the subject, Steno's duct is liable to be opened, producing fistulous wounds, which are difficult to cure; in fact, setons and actual cautery are the only methods which appear to offer any chance of success.

The *skeleton* here comprises the *zygoma*, and the whole *ramus of the jaw.* The superficial position of the former, and the slight consistency of its bones, render it very susceptible of fractures. These fractures are not so dangerous, from the interference of functions, produced by the displacement of the broken portions, but, rather, on account of the inflammation and abscesses, which they may produce in the temporal or zygomatic fossæ. An instrument, passed beneath this arch, would arrive in the zygomatic fossa, or in the cranium itself, if the point be directed slightly upwards.

The *ramus of the inferior maxilla* presents three points of interest: — 1st, Its angle, curved outwards, in some subjects. 2dly, The condyle, which may be fractured at its neck, in which case the external pterygoid draws its inferior extremity forwards, rendering reduction very difficult. 3dly, The coronoid process, which prevents any luxation of the condyle, when the jaws are not too much separated, as it would be arrested by the posterior surface of the malar prominence. Detached from the remainder of the bone, this process, being enveloped by the tendon of the temporal muscle, would be drawn into the temporal fossa. Covered entirely by the attachments of the masseter, fracture of the ramus of the jaw is rarely followed by displacement.

Pterygo-maxillary region.—Internally, the ascending portion of the jaw forms a part of the zygomatic fossa, which had better be described now, as it may be considered a dependence of the masseteric region.

We here find the two pterygoid muscles, disposed in such a manner, that the external is rather a depressor than an elevator of the jaw. The inferior dental nerve and artery, the internal ligament of the articulation, the lingual nerve, &c. descend obliquely between them. Quite internally are the circumflexus, levator palati, and the superior constrictor muscles. The interval separating these latter from the former is filled by cellular tissue, and, frequently, by a prolongation of the parotid.

The branches of the *submaxillary nerve*, implicated in the origin of the external pterygoid muscle, lie superiorly, as does its *auricular* branch, given off from the trunk by two roots, between which passes the middle meningeal artery. The *lingual* and *dental* communicate here, by means of a small twig; the lingual,

in addition, receiving the corda tympani. Situated behind the external pterygoid, above or before which are the masseteric, temporal, buccal, and pterygoid, these branches would be wounded by an instrument traversing the sigmoid notch of the lower jaw. A section can only be made by detaching the parotid gland and arteries from the posterior edge of the jaw, between the two branches of the facial nerve. It would, also, be impossible to reach the dental, or lingual, without trephining the bone beneath the temporal muscle, as performed by M. Waren.

The internal maxillary artery, and its branches, are also distributed in this fossa. All these branches, excepting the middle meningeal, are accompanied by veins, emptying themselves into the jugular, and establishing a circulation between the nose, orbit, and parotid region; with which the pathologist ought to be acquainted.

It may endow neighbouring tumours with pulsation, rendering them likely to be mistaken for aneurism. I once witnessed this in a young man. The tumour, accompanied by the bellows sound and pulsation, was examined by the most eminent surgeons; some said that it was an erectile tumour, others that it was aneurism. The carotid was tied. The patient died on the sixteenth day. We found a medullary mass, in a crude state, beneath the internal surface of the temporal muscle and coronoid process. Retained, on one side, by the bones of the cranium, on the other by the zygomatic arch and coronoid process, it could only be moved by the subjacent artery, towards the temple, and behind the orbit, where the tissues presented less resistance.

At the bottom of the zygomatic fossa, and anteriorly, is the *pterygo-maxillary fissure*, in which we find, from above downwards, the superior maxillary nerve, passing from the cranium into the orbit, the spheno-palatine ganglion, and the origin of its vidian, palatine, spheno-palatine, &c. branches; the termination of the maxillary artery there giving off the four branches,—spheno-palatine, pterygo-palatine, vidian, and superior palatine.

This fossa may easily be penetrated, through the spheno-maxillary fissure of the orbit.

The *bones* composing the pterygo-maxillary fossa are very numerous. Its *anterior wall* is formed, externally, by the posterior portion of the superior maxillary, pierced by several small holes, for the entrance of the posterior dental nerves.

The *infra-orbital canal* commences superiorly and externally. The anterior surface of the pterygoid process, pierced at its base by the vidian canal, terminates it internally. Its *inner* wall, composed of the external surface of the palate bone, is traversed by a groove, converted, inferiorly, into a canal, in the formation of which the preceding wall assists. This is the posterior palatine canal, conducting the artery and nerve of the same name

into the mouth. The pterygo-palatine foramen, through which the vessels and nerves pass into the nasal fossæ, lies above this wall. Polypi of the nose may traverse it, thus presenting themselves in the zygomatic fossa. The superior wall of this latter corresponds to the sphenoidal fissure.

The *skeleton* of the zygomatic fossa comprises, anteriorly, the concave portion of the malar, and the external surface of the malar portion of the superior maxillary bone; superiorly, the zygomatic portion of the greater wing of the sphenoid, to which is attached the external pterygoid muscle; internally, the external surface of the pterygoid process; and, finally, externally, the ramus of the jaw, presenting the orifice of the dental canal near its centre; on account of which disposition fractures of the neck of the condyle, generally, produce less inconvenience than those corresponding to this foramen.

SECTION NINTH.

AURICULO-PAROTIDEAN REGION.

This, properly speaking, corresponds neither to the cranium nor neck. Its form is that of a pyramid, the base corresponding to the skin, and its apex to the pharynx. Limited, superiorly, by the temple and mastoid process, posteriorly, by the anterior border of the sterno-mastoid muscle, and, anteriorly, by the masseteric region, it presents a groove, lost, inferiorly, in the supra-hyoid region, and continuous, superiorly, with the mastoido-auricular depression.

We find, in the parotid region, close to the anterior surface of the tragus, a small eminence, drawn forwards when the jaw is depressed, and representing the condyle. When the mouth is closed, the excavation existing between this eminence and the masseter, in thin individuals, or where the parotid is small, corresponds to the posterior portion of the sigmoid notch of the jaw. In consequence of the superficial position of the condyle, its fractures are easily recognized, by placing the finger upon it, and depressing the lower jaw.

The *skin*, fine, elastic, and free from hair, encloses several sebaceous follicles, and may be raised by subjacent tumours, without undergoing great distension.

The *subcutaneous layer* is composed of dense cellular tissue, the character of which we have described with the masseteric region. In the superior portion of this region we find the ear, which must be examined separately.

Organ of hearing.—Delicate and complicated, as regards its functions, this organ, being only susceptible of surgical considerations in its external and middle portion, will scarcely admit of our treating of the internal ear.

External ear.—The *pavilion*, a kind of oval-shaped horn, having its largest extremity upwards, is so placed that its superior half lies on the temporal region; its posterior portion hides the mastoid process, and its anterior and inferior alone are met with in the parotid region.

Thin, shining, and everywhere free from hair, excepting at the interior of the tragus and antitragus, where a few are commonly met with, the *skin* of the pavilion encloses numerous follicles, in which the sebaceous matter may concrete and accumulate. Fixing the ear to the temple by the centre of the helix, and on the face by the middle of the lobule, it forms two distinct folds.

The *cellulo-fibrous layer*, which comes next, very dense, although lamellous, is separated from the skin by elastic cellular tissue, which never contains adipose vesicles. Purulent collections produce but little pain, but they sometimes destroy the skin with great rapidity, which is one cause of the sinuous ulcers, so difficult to cure. On the contrary, when the abscesses are more deeply seated, they commonly give rise to most acute pain, and sometimes very serious symptoms.

The *five small muscles* of the pavilion do not merit any particular attention; they are the *tragicus*, *antitragicus*, *helicis major*, *helicis minor*, and *transversus auriculæ*.

The *arteries*, which are the posterior auricular, proceeding from the external carotid, and the anterior auricular, derived from the superficial temporal, have *veins* accompanying them, offering no peculiarities.

The *lymphatics* have been imagined, rather than demonstrated. The dense structure of the cellular tissue enclosing them, renders their injection so difficult that hitherto they have been seen but by few anatomists. Mascagni and Cruikshank considered that they passed into the parotid glands, and this opinion appears to be borne out by the swelling of these glands in some diseases of the ear.

The *nerves* are, anteriorly, the superficial temporal of the inferior maxillary, and the auricular branch of the cervical plexus; posteriorly, the mastoid twig of the facial, which has also been described in the occipital region, and the submastoid division of the cervical plexus. Ramifying in a dense compact tissue, they endow the external ear with extreme sensibility, and account for the mischief commonly attendant on its inflammations.

Enveloped in a kind of solid perichondrium, (for which reason Bichat has classed it among the fibro-cartilages of the body,) the *cartilage* constitutes the skeleton of the pavilion of the ear, determining its form, eminences, and depressions. On account of its flexibility it can scarcely be fractured, unless it become ossified, a circumstance of rare occurrence. Its inequalities favour the inflammations, excoriations, cracks, scales, &c. so frequently observed among children, resulting from collections of dirt, &c. But slightly moveable, prominent, an-

elastic, it is often injured by blows and falls. Sutures should always be employed in wounds of this part, and carried through the cartilage; otherwise the irregularities of the organ impede union. In consequence of its solidity, otoplastic operations are rarely attended with complete success.

In the *lobule*, these elements present certain differences, which had better be noticed. The *skin* possesses more venous capillary vessels, whence the livid hue remarked in cold weather, or when respiration or circulation is interrupted. The *cellular tissue* contains extremely small adipose vesicles; and these parts are so blended with the vessels, nerves, and skin, that the lobule in reality forms a homogeneous mass, rather than a complex organ. Enclosing but few structures of much sensibility, its perforation is scarcely painful; nevertheless, inflammations and abscesses give rise to much suffering.

The *auditory canal*, nearly an inch in length, presents an elliptic form when cut across, its vertical diameter being larger than its antero-posterior. Touching the maxillary condyle, it dilates when the jaw is depressed. M. Richerand says, that it is on this account that the mouth instinctively opens when the individual would hear particularly clearly. It is also from this cause, that, in exploring the bottom of the ear, the pavilion must be elevated towards the occipital bone. Corresponding to the mastoid process, posteriorly, it is circumscribed above by the superior branch of the horizontal root of the zygoma; thus, in these two latter directions, it is strongly protected by bone, whilst inferiorly it is nearly exposed. Being narrower in the centre than at its extremities, polypi, and other tumours having pedicles, extend towards the tympanum, or pavilion, according to their seat of origin. Its disposition is such, that its anterior inferior wall is two lines longer than its superior posterior, which distinction arises from the membrana tympani being inclined obliquely, inwards and forwards. M. Lenvir, and others, have demonstrated that the direction and form of the auditory canal undergo several important changes between birth and adult age.

This canal, at first grooved out of the temporal bone, receives a prolongation from the pavilion, the elements of which present certain peculiarities. Its follicles secrete the wax (*cerumen*), which, accumulating and hardening, as is frequently the case among old people, produces deafness. Being narrowest at its middle portion, its secretions are naturally pushed towards the membrana tympani, occasionally perforating it, and leading to its destruction. There is a case upon record, in which the petrous portion was much dilated by wax collected at the bottom of this canal. A young man came under my observation having a tumour, proceeding from the auditory canal towards the exterior of the cranium, containing three teasponsful of atheromatous matter, and implicating the whole of the pavilion, from

the mastoid process to the temple. There are also numerous hairs implanted here, appearing destined to prevent foreign bodies being carried in by the air.

The *cartilage* of the external ear is, as it were, divided into spaces by the fissures of Santorini. One is met with, posteriorly and superiorly, close to the antitragus. Another, better marked, is situated, superiorly and anteriorly, between the helix and tragus. The fibrous tissue, which alone enters into their composition, may be destroyed by the pus from external abscesses; hence, bursting of these latter into the auditory tube. M. G., a practitioner of Touraine, after suffering for eighteen days from inflammation of the intestines, was attacked by abscess of the parotid gland, which, after six days, burst into the ear by the last-named fissure. A similar instance occurred in November 1832, in a man suffering from critical abscess of the parotid. From the inequalities of this cartilage, the irregularity of its external surface, and of the osseous circle receiving it, the cellular tissue investing it being either filamentous, lamellous, &c., fully accounts for the character and frequency of its inflammations and collections.

Besides the *arteries* already noticed in the description of the external ear, the canal receives branches from the stylo-mastoid and posterior deep temporal.

The *veins* present nothing of importance, in a surgical point of view. The same may be said of the *nerves*, among which we occasionally find a filament of the great sympathetic anastomosing with the facial.

Middle ear.—The *tympanum* may be considered as an enlargement of the preceding canal, from which it is separated by a thin brittle membrane. Beneath lies the glenoid cavity. Corresponding, anteriorly and internally, to the carotid canal, it may, to a certain extent, account for the whizzing occasionally complained of by patients affected with aneurism. Its relation with the glasserian fissure allows of blood, pus, or other fluids penetrating the cavity of the tympanum by the temporo-maxillary articulation, and reciprocally.

The *mastoid process* lies posteriorly and externally. As its cellules are only separated from the tympanum by mucous membrane, they are easily implicated in abscess of the ear. This gave rise to the recommendation of trephining on this part, but it is very doubtful whether such an operation is ever productive of much benefit. The areolar form of the bone leads to infiltration, rather than collections, of pus, usually accompanied by caries and necrosis.

In 1823, M. Bernard showed me an infant in whom the mastoid process was traversed by an anormal auditory canal; but I cannot agree with M. Blandin, who relates the same fact, that this would be a reason for adopting perforation of the mastoid process, in order to give access to air. Such a perfora-

tion would not remain, even if a foreign substance were introduced; and it cannot be substituted for perforation of the membrana tympani.

Its *superior wall* is thin, corresponding to the anterior surface of the petrous bone. We here remark vascular foramina, forming a communication between the dura mater and the mucous investment of the tympanum; and, in the infant, sometimes even in the adult, a trace of a suture, traversed by cellular prolongations, or emissary veins. This disposition accounts for meningites succeeding acute otitis, the noise in the ears in diseases of the brain, and the discharge of blood through the ear, after falls and blows on the head, &c.

Tumours, proceeding from the dura mater across the auditory canal, are also accounted for by this arrangement. Its external wall is formed by a membrane of a horny nature, termed membrana tympani, invested by the external and internal integuments. The opening in this wall, considered natural by Rivinus, Scarpa, and Mechel, is probably merely an anomaly, or the result of accident; however, when it does exist, we can readily account for the passage of smoke, air, &c. from the mouth through the ear. It rarely influences or interferes with hearing, unless there be disease of the organ. The enlargement terminating the handle of the malleus, fixed between the layers of the membrane upon which it acts, a little beneath and anterior to its centre, the operation recommended and practised by Portall, Celliez, and before them by Riolan, should be performed, beneath, and on the anterior half of the membrane. The same precaution must be observed in perforation; and in these operations we should guard against introducing the instrument too deeply, lest we wound the corda tympani nerve, which passes from the posterior wall of the cavity, and emerges by the glenoid fissure.

Internally and anteriorly is the *orifice of the eustachian tube*, running, obliquely, between the petrous and squamous portions of the temporal bone, towards the upper part of the pharynx, where it terminates behind the meatus of the nose, enlarging, as it proceeds from the tympanum towards the fauces; a sound may, therefore, be introduced with facility through this latter cavity.

The internal membrane, prolonged from that of the pharynx, fixed very distinct in some individuals, especially towards the mastoid cells, envelopes the chain of bones in the ear, but does not penetrate the labyrinth, in consequence of the membranes closing the foramina (*rotunda and ovale*). It is, consequently, liable to the same affections as the mucous membranes of the fauces; and the cellular tissue, uniting it to the bones, being very dense, inflammations of the ear are attended with great pain.

The interior of the tympanum receives its *arteries* from the

stylo-mastoid. The internal carotid, also, furnishes some branches. In addition to these, a branch from the middle meningeal enters through the canal, for the internal muscle of the malleous, and one from the internal maxillary, through the glasserian fissure.

Its *veins* exactly follow the course of the arteries, and offer nothing of interest. The *emissaries* found at its upper part possess no valves, and empty themselves into the sinus of the dura mater.

Its *lymphatics* have never been injected. Its nerves appertain to the facial, the carotid plexus, and spheno-palatine ganglion. Their numerous anastomoses explain how diseases of the internal ear excite so much sympathetic disturbance. We have already mentioned the corda tympani, formed by the vidian nerve: when we consider, that, in traversing the cavity, it passes above the malleus, we find another reason for perforating the membrane at its inferior portion. With so complex an organization, its numerous diseases are not surprising. The slightest swelling of the eustachian tube prevents communication with the pharynx, and causes deafness. Irritating fluids, and other matters accumulated in the cavity, not finding any issue, react upon all the membranes, which, retained by the bones, cause intense suffering. Suppuration, before perforating the membrana tympani, most frequently disorganizes the chain of small bones; and when it occurs in the mastoid cells, the tissue of which is porous, and disposed in lamellæ, it quickly leads to caries. Invading the periosteum, it separates it from the bones. This, quickly followed by a similar effect upon the anterior and posterior surface of the petrous portion, causes necrosis. The auditory, facial, and great sympathetic nerves, participating in the mischief, the brain, in its turn, becomes affected; hence delirium, abscess in its substance, all the symptoms of arachnitis, encephalitis, and too frequently death, in consequence of severe otitis.

Finally, we may understand, from the relations of the tympanum to the fauces, why angina and swelling of the amygdalæ are so frequently succeeded by deafness.

Parotid portion.—The *parotid* gland covers, anteriorly, the posterior border of the jaw, prolonged more or less on its external surface. Between this bone and the gland, we find from above downwards,—

1. The superficial temporal vein and artery.
2. The facial nerve, crossing the vessels opposite the neck of the condyle, and enveloped in the deep portion of the gland.
3. The facial, or transverse facial arteries.
4. Several large veins, ramifying in the secreting tissue.
5. Finally, the cervico-facial branch of the seventh pair of nerves, the termination of the stylo-maxillary ligament, and the masseter muscle.

Posteriorly, the parotid, attached firmly from above downwards, at first to the auditory canal, subsequently to the margin of the mastoid process and sterno-mastoid muscle, covers the posterior auricular artery, and still more inferiorly, another, sometimes larger than the preceding.

Internally, or deeply seated, it lies on the trunk of the facial nerve, and the three small branches which it gives off at its exit from the stylo-mastoid foramen. It is next placed on the styloid process, and muscles arising from it; on the digastric muscle, afterwards, a little more anteriorly; on the styloid artery, and several anonymous branches traversing the gland, on the trunk of the external carotid, posteriorly to which the gland sends a prolongation, sometimes extending for a great distance; finally it is prolonged between the pterygoid muscles and styloid process, as far as the pharynx, passing between the external carotid and the stylo-maxillary ligament, to become continuous with the submaxillary gland.

These numerous important relations render extirpation of the parotid so dangerous, that we may affirm, that it never was performed before the time of Beclard, and that, among the numerous cases which have since been published, few have been conclusive. It is evident that the operation cannot be completed, without tying the carotids. The facial nerve would, of necessity, be wounded, as would the internal jugular vein, the occipital, superficial-temporal, and internal maxillary arteries. Each of its lobes is enveloped in a small, dense, cellular sack, and united to the others, by still denser filamentous tissue. It is in this tissue that phlegmonous inflammations appear to be situated, whilst tumours, more particularly, implicate the glandulous texture.

The granules of the gland are too dense for the inflammation to remain any length of time, in their substance, without extending to their external layer, and without the secretion of pus into the cellular tissue. I have, moreover, observed, in several instances of malignant fever, that these glandules, and the various excretory ducts, are frequently the seat of suppuration.

The parotid is enclosed in a kind of general envelope, the dense external layer of which is derived from the aponeurosis covering the sterno-mastoid temporal muscles, &c. proceeding to the external surface of the masseter. Its internal or deep layer comes from the same parts. Unequally disposed, it forms a sheath for the whole of the vessels, envelopes all the eminences formed by the glands between the muscles, afterwards uniting with the preceding. Above, and external to the digastric, these two laminæ are continuous with the cervical fascia and stylo-maxillary ligaments. Finally, behind the angle of the jaw, and within the internal pterygoid, they unite the parotid to the submaxillary gland, equally furnishing a sheath to each.

The dense structure of the elements enveloping and uniting

the granules of the parotid gland, explains why, in suppuration, the pus is so seldom disposed in collections, and why these collections are recognized with so much difficulty, when they occur beneath the aponeurosis; and why, in some cases, they incline towards the deeper seated parts, the pharynx, tongue, &c. for instance, or towards the auditory canal, into which they frequently open. These considerations lead to the practice of making early incisions into tumours of the parotid region suspected of containing pus.

The parotid is separated from the skin by a layer of cellular tissue, enclosing some fibres of the platisma, filaments of the facial nerve, an ascending branch of the cervical plexus, and sometimes veins, which empty themselves into the external jugular. It rarely encloses fat. As it adheres firmly to the gland and integuments, tumours rarely acquire any great degree of magnitude, and are generally scarcely moveable.

Muscles. — Besides those forming the boundaries of this region, we find the small complexus, posteriorly, between the sterno-mastoid and the attachment of the digastricus; on the spine, the lateral rectus, the rectus anticus major and minor; internally, the stylo-hyoid, the stylo-glossus, and stylo-pharyngeus, between which the gland sends its prolongations, and the division of which, in its extirpation, would derange the functions of the larynx, tongue, and pharynx; more deeply seated, the constrictor of the pharynx, and, anteriorly, the pterygoid muscles. The stylo-maxillary ligament, situated more inferiorly, internally, and posteriorly, should be preserved in operations, in consequence of its relation to the stylo-glossus muscle, and its attachment to the os-hyoides.

The *arteries* are the trunks of the two carotids, and most of the branches furnished by the external; such being the occipital, pharyngeal, stylo-mastoid, the commencement of the internal-maxillary, superficial-temporal, and transverse facial. Thus wounds, operations, &c. of this region are attended with considerable danger.

The *external carotid*, at first placed very deeply, internally opposite to, and slightly above, the digastric and stylo-hyoid muscles, afterwards ascends behind the condyle of the jaw, forming an arch, with its convexity outwards. In this latter situation, as posteriorly, it is enveloped in the gland; anteriorly, it is separated from the posterior border of the maxillary bone by a large vein. The cervico-facial branch of the seventh pair of nerves crosses it obliquely, on its outer surface. All these relations are of the greatest importance, in extirpation of the parotid, dislocation, amputation, and fracture of the ramus of the jaw.

The *internal-maxillary*, given off by the carotid opposite the neck of the condyle, about two inches above the angle of the jaw, is merely contiguous to the parotid gland; posteriorly, immediately passing to the internal surface of the neck of the

maxilla, it plunges between the pterygoid muscles, and may cause considerable hemorrhage, from being ruptured, in fracture of the neck of the bone.

The *superficial-temporal*, the continuation of the carotid, proceeds outwards, in front of the auditory canal. Anteriorly, it is merely separated from the condyle, by its collateral vein, and dense cellular tissue. Covered, posteriorly, and externally, by the parotid, afterwards by the commencement of the auditory canal, it is, nevertheless, sufficiently close to the skin to be tied, when circumstances render this necessary.

The *occipital*, situated deeply at the bottom of this region, at first placed posterior and internal to the stylo-hyoid muscle, passes immediately between the internal jugular vein, which it crosses nearly at right angles, and the digastric muscle, to reach the internal surface of the sterno-mastoid. Adhering but slightly to the gland, it presents but little opposition to its removal.

The *styloid*, ascending towards the stylo-mastoid foramen, is separated from the preceding, which lies internal to it, by the stylo-hyoid muscle; and from the external carotid, which is anterior, by a prolongation of the parotid gland. The posterior auricular branch, from which it arises, at about an inch below the styloid foramen, traverses the gland, to reach the mastoido-auricular depression, and is consequently much exposed, in the division of the facial nerve, at its exit from the cranium.

The *transverse-facial* adhere so intimately to the parotid, behind the masseter, that in the living subject they cannot be separated.

Numerous anonymous arteries, proceeding from those already described, also ramify in the gland, constituting its proper vessels, but these are not of sufficient size to require any especial description.

The *veins* generally accompany the arteries, but in addition there are numerous branches on the surface, and in the substance of the gland, which, uniting, form the external jugular vein. Besides these, we find the anastomotic branch of the two jugular veins, in the inferior portion of this region, a little below the styloid process.

The internal jugular, lying deeply anterior to the transverse process of the cervical vertebræ, behind and within the styloid process and its muscles, the parotid gland, and all the arteries, excepting the internal carotid, which lies on the side of the pharynx, is crossed at this point by the hypo-glossal and spinal nerves. Its relations with the carotid artery, great sympathetic, and pneumo-gastric nerves, resemble those in the neck.

Nerves.—We find, in the subcutaneous layer, the anterior auricular nerve, from the *cervical plexus*, the principal branch of which accompanies the external jugular vein. The *spinal accessory*, directed at first, obliquely, between the internal jugular vein

and digastric muscle, next traverses the posterior and inferior lobules of the gland, to pierce the sterno-mastoid muscle.

More deeply seated, we meet with the glosso-pharyngeal, and hypo-glossal, placed, the one internally, and the other externally, but both anterior to the internal jugular vein and carotid.

The *pneumo-gastric* descends behind the vessels, and furnishes its pharyngeal branch or twig, in this region. Nearer the bone, lies the superior cervical ganglion of the great sympathetic, with the filaments running to form the carotid plexus.

Emerging from the stylo-mastoid foramen, after giving off three small branches, the *facial* descends obliquely, outwards and forwards, across the deep lobes of the parotid. It should be divided at this point, when we would suspend its action, or deprive it of sensibility. It may be reached without difficulty, by carrying an incision, from behind the ear, to beneath the mastoid process, from which the gland may be separated, by drawing the anterior lip of the wound forcibly forwards. Proceeding with great precaution, the nerve is found at the depth of about six lines, in the centre of the space dividing the fibrous canal of the ear from the apex of the mastoid process. The posterior auricular and sub-mastoid arteries, lying immediately upon this eminence, are avoided by carrying the incision rather more anteriorly.

Traversing the parotid, to arrive at the external portion of the superficial carotid, the facial nerve divides into two branches.

The *temporo-facial*, ascending towards the centre of the zygomatic arch, is so situated as to be exposed with facility, by an incision of three or four lines, anterior to the union of the lobule of the ear with the skin of the face, or eight lines beneath the horizontal root of the zygomatic process, or on the neck of the condyle of the jaw. The incision should always be made, obliquely, from above downwards, and backwards, thus avoiding the temporal artery. There is also some danger of wounding the transverse facial, but they are easily compressed on the masseter. As the action of the nerve is not necessarily destroyed by this operation, (the cervico-facial branch remaining,) it would be better to perform it anterior to the mastoid process, otherwise, as in two cases by M. Roux, the disease may return in the undivided branches.

The *cervico-facial branch*, descending obliquely towards the angle of the jaw, runs to the supra-hyoid region, where we will trace it.

The distribution of the seventh pair, in the parotid region, proves that it is nearly impossible to perform any deep-seated operation without injuring it; and that, besides the dangers usually attending injuries of this situation, we must enumerate paralysis of the face. In fact, this is one of the most frequent accidents resulting from extirpation of tumours, or of the

parotid itself; from gangrene, or inflammations attended with loss of substance, and some accidental wounds.

The *lymphatics* possess glands meriting particular attention, inasmuch as they receive nearly all those of the exterior of the cranium, and some from the face, mouth, and pharynx. Some of these glands are placed on the surface of the parotid, and others more deeply between it and the other structures of the region. We commonly meet with two or three anterior, and beneath the mastoid process. Their enlargement, frequently the result of diseases of the skin of the cranium, or sides of the face, sometimes leads to the necessity of removing them; and taking the relation of parts into consideration, the cases of removal of the parotid gland, related by various authors, are probably extirpation of one or other of these glands. I have, upon ten occasions, extirpated tumours of this character, and have then observed how easily one may be deceived upon this point. In one case, the diseased glands were disseminated through a mass of hard granulated fat, so perfectly analogous to the tissue of the parotid, that every body was in doubt upon the subject, even after careful dissection. Finally, there are some which, situated between the sterno-mastoid muscle and internal jugular vein, form the commencement of the *sub-mastoid chain of glands*. These receive their vessels from the deep-seated parts, and may, by increasing in size, resemble aneurism, compress the blood vessels, and produce serious mischief.

Skeleton.—The bones of this region are situated superiorly, posteriorly, and anteriorly. We observe, in the former situation, the inferior surface of the petrous portion of the temporal bone, the glenoid cavity, the carotid foramen, the occipito-petrosal suture; presenting, posteriorly, the posterior lacerated foramen, giving exit to the internal jugular vein, and eighth pair of nerves; the basilar process, to which are attached the anterior recti muscles of the head. Posteriorly, are the anterior condyloid foramen for the hypo-glossal nerve, and the styloid foramen for the facial. In the second, there is merely the anterior surface of the transverse processes of the three superior cervical vertebræ, upon which repose the anterior branches of their corresponding nerves. In the third, we find the posterior border of the jaw.

I cannot quit this subject without reverting for a moment to the *temporo-maxillary articulation.*

The *glenoid cavity*, bounded, posteriorly, by the styloid and vaginal processes and the vertebral column, does not admit of dislocation of the condyle in this direction. The spine of the sphenoid bone prevents all displacements internally, and opposes, for the same reason, luxations externally, since one of the condyles cannot be forced outwards without the other being carried inwards. It is, therefore, solely anteriorly that the max-

illary bone can be displaced, and even this cannot occur during infancy, as, at that period of life, the acute angle, by which the two bones articulate, presents an insurmountable obstacle.

The articulation, being merely separated from the skin by a single ligament, is easily opened into by wounds. The reddish cellular tissue, filling the posterior portion of the glenoid cavity, forms a kind of cushion, which divides the condyle from the auditory canal, but allows of its approximating considerably in forced retractions of the jaw; this cushion in part closes the Glasserian fissure, and prevents direct communication between the articulation and the middle ear. Internal to the fissure, and without the articulation, are the corda tympani and the auricular branch of the inferior maxillary nerves; hence the possible obliteration of these nerves, in diseases of the articulation. Horizontally divided into two by fibro-cartilage, it may be the seat of two distinct dropsical effusions. In consequence of this arrangement, some attention is required in separating the condyle. We may understand, from its situation, how its inflammations may implicate the functions of the ear, pharynx, tongue, lungs, larynx; in short, the whole head.

Remarks.—With such an abundance of nerves, it is evident that tumours and inflammations are necessarily accompanied by intense general reaction, and that operations and wounds must be very painful. The size and number of the veins explain the frequency and extent of ecchymosis, succeeding contusions and fractures of the ramus of the jaw. The salivary canals, in their turn, cause wounds of any depth to remain fistulous, the more so the nearer they are situated to the jaw. Being unsustained internally, the parotid is easily depressed, rendering plugging of little service in hemorrhages of this region. Finally, although the parotid excavation allows of compression being easily established there, it also renders the treatment of wounds extremely delicate, and causes swelling of the parts to extend promptly over the jaw and mouth.

CHAPTER FOURTH.

OF THE NECK.

The most contracted portion of the body, placed between the head and thorax, the *neck* varies considerably as to its length, according to the corpulence and form of individuals. Thick and very short in some, it is, on the contrary, small and very long in others. When the former depends merely upon corpulence, it is ordinarily accompanied by predisposition to apoplexy. The latter is remarked in phthisical subjects. Considerably enlarged transversely at its lower portion, in uniting with the shoulders, it, for the same reason, descends less posteriorly than anteriorly; but its free portion, ascending further in the former direction, in consequence of the face, thus re-establishes the equilibrium in this point of view. In infancy and young females its inequalities are scarcely perceived, whilst, in adult man, we distinguish a series of depressions and eminences on its surface. In fact, we find *supra-sternal*, *thyro-maxillary*, *sterno-parotidean*, *supra-clavicular*, *sterno-cleido*, and *sub-occipital depressions*, and laryngeal, sterno-mastoid, and trapezoid eminences, &c., all of which serve as indications for surgical operations. One of these, that which belongs to the sterno-mastoid muscle, is a proof of this assertion. Proceeding diagonally, from the sternum in front, to the occiput posteriorly and laterally, this muscle requires a special description, since, appertaining to several regions at once, it would be difficult to allot it to any one in particular. The bifurcation of its inferior extremity is marked, externally, by a depression, exactly corresponding to the primitive carotid. It limits the supra-clavicular fossa by its posterior, and the sterno-parotid depression by its anterior border. Its relation to the principal nerves and vessels of the neck, gives rise to most important surgical considerations. Pierced, rather above its centre, by the spinal accessory nerve, it may be influenced by diseases of this cord. Crossed, nearly at the same point, by the external jugular vein, were it not for the nerve, its external surface would be the spot for phlebotomy of the neck. The prominence formed on each side is the reason why suicides so rarely injure the vessels, in their attempts at self-destruction. By joining the borders of the trapezius muscle and the clavicle, it, in a similar manner, protects the subclavian vessels, and the commencement of the brachial plexus of nerves. Its insertion on the mastoid process explains the rotary motion with which it endows the head, when acting singly on one side, and the distortion characterising wry-neck (*torticolis*). Its contraction being the cause of this affection, even should the dis-

ease be permanent, it may be cured by complete division of the muscle, unless the operation be contra-indicated from other causes.

Finally, the neck is naturally divided into three regions,—the *anterior*, *supra-clavicular* or *lateral*, and the *posterior*.

SECTION FIRST.

ANTERIOR PORTION.

The anterior portion of the neck comprehends the collection of organs placed anterior to the cervical portion of the spine. We here see the *supra-sternal fossa*, the *laryngeal*, and *sterno-mastoid eminences*. The supra-sternal fossa extends to the parotid region, thus forming on each side a groove, which, large and deep superiorly, is superficial and indistinct in the middle, taking the name of *thyro-mastoid groove*. Between the larynx and the maxilla, is observed the *thyro-maxillary groove*, placed transversely, lying upon the os hyoides. These various objects subdivide the anterior of the neck into two secondary regions; one superior submaxillary, or supra-hyoid, may also be called *sublingual*; the other, inferior and less, the *sub-hyoid*.

Supra-hyoid region.—Limited above by the base of the jaw and floor of the mouth, laterally by the anterior border of the sterno-mastoid muscle, larger in the middle; this is, moreover, continuous with the parotid region. The oblique plane which it forms, from above downwards, rising and falling with the motions of the tongue, is transformed, in some individuals, into a decided projection, or semilunar prominence, separated from the jaw by a fissure. This constitutes *double chin*.

Fine, thin, very elastic in children and females, thicker in man, on account of the beard, the *skin* frequently presents transverse furrows, which always remain, notwithstanding the position of the head, depending upon the action of the platisma muscle, perhaps, as much as upon the motions of the jaw. The follicles are larger here than in the other regions of the neck, but less than in the face; consequently, pustular affections are very common.

The subcutaneous tissue consists of three layers. Formed of cellulo-filamentous tissue, containing adipose vesicles, ordinarily very minute, but capable of increasing to a considerable extent; thus constituting that submental projection already mentioned. The *first* unites the skin to the platisma muscle, so firmly that, in contracting, it draws the integuments with it. The *second* consists of the platisma muscles, which, on the median line, leave a small triangular space between them, having its base downwards. The *third*, formed of cellulo-lamellous tissue, united very loosely to the cervical fascia, upon which it moves, adheres

more firmly to the fleshy membrane, whose motions it follows. The external jugular veins lie beneath this latter, which, by its loose texture, allows pus easily to collect into abscesses, and, for the same reason, to burrow downwards, quickly producing extensive mischief. Therefore, when fluctuation can be felt, the abscess should be opened in the direction of the fibres of the platisma.* The great elasticity of this membrane, also, allows of tumours acquiring considerable magnitude, without disorganizing the skin; preserving, in general, considerable mobility. Simply cellular in some individuals, the supra-hyoid fascia is decidedly fibrous in others. Continuous, posteriorly, with that of the parotid gland and masseter muscle, it is attached, anteriorly, to the base of the maxillary bone. Before uniting on the os hyoides with the *fascia cervicalis*, it receives a strong layer from the anterior portion of the digastric muscle, and becomes double on each side, and posteriorly. Its anterior portion alone descends into the sub-hyoid region; the posterior, at first forming a sheath for the sub-maxillary and sublingual glands, finally loses itself in the floor of the mouth, supplying sheaths to the muscles of the tongue.

The study of the supra-hyoid fascia is important, more especially from the changes which it undergoes during the developement of diseases, situated between its external surface and the skin, and those occurring behind and above it. Abscesses in the latter situation always, in fact, tend towards the mouth or pharynx, in consequence of the resistance offered by this aponeurosis anteriorly; and, for the same reason, even when the abscess is considerably developed, fluctuation cannot, for a long period, be detected externally. The lamellous nature of this fascia allows it easily to resolve into cellular tissue, and accounts for the various degrees of thickness which it presents.

The *supra-hyoid muscles*, upon which the motions of the larynx and inferior jaw, in some degree, depend, belong more especially to the tongue.

The *digastric*, whose anterior belly mounts, obliquely, from the os hyoides to the submental fossæ, in contact internally with its fellow, covered anteriorly by aponeurosis, lying posteriorly upon a portion of the mylo-hyoid muscle, forms an arch, separated from the maxillary bone by a space, varying every moment during the elevation or depression of the larynx or jaw, and always filled by the sub-maxillary gland. Its posterior belly,

* This recommendation does not hold good in bleeding from the jugular vein. The surgeon should, in opening the vessels, cut across the muscular fibres; otherwise the muscle, put upon the stretch by the chin being directed over the opposite shoulder, closes the incision made in the course of the fibres, preventing the flow of blood externally, but leading to its effusion into the loose cellular tissue above described. Consequently, as the fibres of the platisma are directed from below upwards, forwards, and inwards, the surgeon, having first placed his finger upon the vein, above the clavicle, directs the incision from below backwards, upwards, and outwards.—H. H.

ascending to the parotid region, lies between the external maxillary artery, situated externally, and the lingual nerve and artery, internally.

The *stylo-hyoid*, bifurcating to form a passage for the tendon of the latter, furnishes an expansion to the cervical aponeurosis, and is inserted into the os hyoides. The *mylo-hyoid*, covered by the digastric, is divided from the buccal membrane by the sublingual gland and mylo-hyoid nerve. Internally, a prolongation of the sub-maxillary gland and hypo-glossal nerve, the gustatory nerve, and lingual artery, prevent its being in immediate contact with the genio-glossal and hypo-glossal muscles; but quite anteriorly it touches the genio-hyoid, which forming a small column, extending from the genal process to the bottom of the os hyoides, appears only to be the inferior portion of the genio-glossus.

The *hyo-glossus* is perforated by the lingual artery, at some lines above its attachment to the os hyoides, in such a manner as to cover a small portion posteriorly; whilst, subsequently, it is itself covered by the muscle.

Mylo-hyoid space.—The hyo-glossus muscle is separated from the jaw by the termination of the stylo-hyoid, and the tendon of the digastricus, circumscribing a *triangular space*, the internal side of which is formed by the muscle, the superior by the jaw, the inferior by the fascia, which, terminating, posteriorly, in the parotid region, is prolonged, anteriorly, towards the tongue, between the mylo-hyoid and genio-glossus muscles.

The *stylo-glossus*, a small fasciculus situated behind the preceding, lies between the jugular vein, the internal carotid artery, and the nerves, emerging through the posterior lacerated foramen internally; the external carotid, the facial, and lingual arteries and veins, the hypo-glossal, and fifth pair of nerves, externally.

The *genio-glossus*, the most voluminous and important of all, is attached by its apex to the genal process. Its fibres diverging, and forming a sort of fan, terminate along the whole extent of the inferior surface of the tongue. Its principal function being to carry the base of the tongue forwards, at the same time that it elevates and draws the larynx in the same direction, its motions may be impeded after amputation of the jaw.

Arteries.—We find, posteriorly, a small portion of the two carotid arteries. External to the *internal* the *external carotid* is crossed by the digastric and stylo-hyoid muscles, the hypo-glossal nerve, the parotid gland, and fascia; posteriorly are, the internal jugular veins, and the anastomotic branches of the great sympathetic nerve with the first cervical. Internally, it is separated from the internal carotid by the inferior pharyngeal artery, the stylo-glossus, and stylo-pharyngeus muscles. The *internal carotid* is here found, in the same relative position that has been already described, in the pharyngeal and parotid regions.

The facial or external maxillary follows the direction of a line, drawn from the posterior extremity of the greater cornea of the os hyoides, to the anterior of the masseter muscle. It is tortuous and covered by the digastric, the stylo-hyoid muscles, the facial vein, and sub-maxillary gland, before it curves over the margin of the jaw, and furnishes the submental, which runs along the attachment of the mylo-hyoid to anastomose with the corresponding artery of the opposite side; passing between this muscle and the anterior portion of the digastric. This latter branch, the only one which must necessarily be divided in amputation of the jaw, is rarely of sufficient size to cause hemorrhage of any importance; at all events it is easily secured. Before giving this off, the facial artery furnishes numerous large branches to the sub-maxillary and lymphatic glands. Being very superficial, this artery may be opened in wounds and operations; therefore, it should always be tied before the extirpation of tumours, however small, situated deeply beneath the jaw.* It is exposed with facility between the cornua of the os hyoides and the sub-maxillary gland, and it will suffice to make an incision extending from the latter organ as far as the anterior of the sterno-mastoid muscle, in accordance with the line indicated above. The parts to be divided are, the skin, platisma, fascia, (from which the artery is separated merely by cellular tissue,) and, sometimes, the facial vein, between the sub-maxillary gland and the digastric muscle.

The *lingual* is situated a little lower than the preceding; and on its internal side it is crossed by the lingual nerve, before passing into the hyo-glossus muscle; previously, its relation to the muscles is the same as that of the facial. Advancing between the hyo and genio glossus muscles, it is accompanied, inferiorly, and externally, by the hypo-glossal nerve; and after giving off the sublingual, it terminates by taking the name of *ranine*. In its course between the os hyoides and the superior portion of the hyo-glossus muscle, it merely furnishes some small unimportant branches, and occasionally the submental. It occurs from this, that in applying a ligature in the different diseases of the tongue, and especially in fungus hæmatoides, the incision should be made transversely, having its anterior extremity prolonged to the chin. The ligature should be applied at some lines beneath the sub-maxillary gland. The artery may then be secured, behind the hyo-glossus muscle, by separating the nerve crossing it; or, rather, beneath the muscle itself, by dividing its fibres, which form a very thin layer over the vessel. Finally, to distinguish it from the external maxillary, it will

* This appears to me to be a very unnecessary precaution. For even should this artery be divided, the hemorrhage likely to ensue is easily arrested by the fingers of an assistant placed upon its divided portions, or by compressing the trunk of the carotid against the cervical vertebræ. At all events, a ligature may be applied then, instead of submitting the patient to the pain and inconvenience of a previous operation.—H. H.

suffice to remark, that the latter passes above, and internally to the gland, whilst the lingual lies more inferiorly. Large, and more numerous than the arteries, which they do not immediately accompany, the *veins* are, generally speaking, less tortuous. The *facial* especially should be examined in its different relations. At first, placed externally, afterwards, posteriorly to the artery of the same name, it leaves it in descending, and empties itself into the internal jugular. This vein, ordinarily running beneath the fascia, in its passage from the genal to the sub-maxillary regions, is, occasionally, found between the fascia of the neck and the platisma. It then forms what is termed the *external jugular*. Nevertheless, it must be understood that this latter exists, although the facial follow its habitual course. The other veins, generally, accompany their arteries, and empty themselves into the internal jugular vein.

The *lymphatic glands* are very numerous in this region; several are met with posteriorly, superiorly, and anteriorly to the carotids; others surround the sub-maxillary gland. There are two or three above this gland, lying upon the facial vessels; and we also meet with others between the mylo-hyoid muscle, the jaw, the digastric muscle, and aponeurosis. These various glands, receiving the lymphatics of the pharynx, of the interior of the mouth, and those of the face, swell in numerous acute and chronic affections; they, consequently, merit great attention. Their developement is such that they are frequently mistaken for diseases of other organs. The most remote have given rise to suspicion of aneurism. Those in the neighbourhood of the maxillary gland have been mistaken for swelling of the gland itself, and the most anterior, being firmly bound down by the aponeurosis against the bone, have been considered adherent cancers, which surgeons have feared to touch. In this respect I can say, with Colles and Burns, that most of the extirpations of the sub-maxillary gland, hitherto cited, would be more properly described as removals of these lymphatic glands. Converted into fungus hematoides, and prolonged as far as the pharynx above the larynx, they formed, in a patient whom I saw in 1830, a livid tumour, the pulsations of which were so evident, that there was great difficulty in distinguishing it from aneurism.

During the October of 1823, a young person was admitted into the hospital of the School of Medicine, having a very hard tumour, as large as an egg, situated beneath the maxillary bone, at the point corresponding to this gland. M. Bougon removed it, and it was at first thought that the salivary gland was the part extirpated, but upon a more attentive examination, this was found pushed inwards, and the tumour was formed of several disorganized glands of the mylo-hyoid space.

Enclosed within a fibrous sac, prolonged from the parotid sheath and posterior layer of the fascia, the *sub-maxillary gland* is frequently continuous, posteriorly, with the parotid. It bifur-

cates, anteriorly, to embrace the posterior margin of the mylo-hyoid muscle, nearly filling the whole of the space described in speaking of the hyo-glossus muscle. It touches the supra-hyoid fascia, externally or inferiorly, and may be felt through the skin; the facial vein is also applied upon it in the latter direction. Externally and superiorly, it lies upon the internal surface of the jaw, receiving the mylo-hyoid nerve. Internally it is separated from the mylo-hyoid muscle by cellular tissue, and the lingual and gustatory nerves. Finally, the facial artery is found, at its posterior, internal, and superior portion, so closely attached to it, that in some individuals it is, as it were, enveloped in the granulations. The lingual nerve is always placed near the internal surface of its inferior border, whence it is soon separated by the hyo-glossus muscle. Limited, inferiorly, by the sheath of the digastric, it follows all the movements with which this muscle endows the larynx; consequently, when we would render it prominent, as for extirpation, we should turn the head forcibly backwards. What I have said with regard to the lymphatic glands, would lead to doubt of this operation having ever been performed. Nevertheless, as the sub-maxillary gland is encysted, it would be possible, after tying the facial artery, to extract it, without injuring any organ of importance.

The *whartonian duct* lies between the mylo-hyoid and genio-glossus muscles, ascending towards the sublingual gland and sides of the frenum. The two principal nerves of the tongue accompany it, above and below, for some extent. Of its three tunics, the firmest which it receives is from the fascia. Its dilatation constitutes ranula, and its relative position shows, that even if a large portion of this tumour can be without danger removed through the mouth, it cannot through the sub-maxillary gland.

Nerves.—These are superficial and deep. The lingual, placed at first external to the carotid artery, internal and above the stylo-hyoid and digastric muscles, runs immediately beneath the maxillary gland, crossing the lingual artery, and ascending to the external surface of the hyo-glossus muscle, anterior to which it furnishes numerous filaments, and is finally lost in the tongue. This trunk, the means of communication between the fifth and eighth pairs, by the supra-hyoid and glossal branches, establishes, in the second place, some relation between its branches and the cervical plexus, by the descendens-noni nerve, and is easily exposed, through nearly its whole extent, especially in the direction of a semicircular line, drawn from the anterior border of the sterno-mastoid muscle, opposite the angle of the jaw, to the body of the os hyoides. The incision should then follow the curve, separating the digastric muscle from the inferior circumference of the sub-maxillary gland.

The *gustatory branch of the fifth* descends beneath the mucous membrane of the mouth, above the sub-maxillary gland, between

the superior portion of the hyo-glossus muscle, to which it nearly approximates, and the internal surface of the jaw, from which it is divided by the gland. Arrived in front of the hyo-glossus muscle, this nerve plunges in the genio-glossus, running to the papillæ of the tongue; but previously it anastomoses, on the one hand, above the secreting organ, with the mylo-hyoid branches of the inferior dental nerve; and, on the other, with the lingual, before it plunges into the muscular fibres, internal to the whartonian duct. If its division be necessary, we must seek it behind the jaw, as it is almost impossible to reach it in the region we are now examining. We also meet with some filaments of the glosso-pharyngeal, at the posterior portion, and pneumo-gastric, and great sympathetic, descending between the carotid and the internal jugular vein.

The *superficial nerves* are derived from the cervical plexus, and the inferior branch of the facial; the former remain on the external surface of the aponeurosis, the latter ramify in the sub-cutaneous cellular tissue. Numerous, and enclosed in a dense membrane, they explain the great sensibility of the skin in this region, and the violent pain and nervous affections sometimes accompanying its inflammations. Being almost inevitably divided in extirpations of sub-maxillary tumours, they account for the paralysis of the lower lip, occasionally succeeding this operation.

The *cellular tissue* between the muscles is very fine. Beneath the fascia it is lamellous, enclosing adipose vesicles. It runs in large quantities into the sub-maxillary gland, enveloping each of its granules, and sending prolongations between them. When suppuration occurs in this salivary gland, or the parotid, or, in fact, in any gland of a similar character, it usually commences in this membrane, as the proper glandulous structure does not appear susceptible of primitive inflammation. Continuous with that from the sides of the pharynx and tongue, more abundant laterally and posteriorly than in the middle, it follows, that deep suppuration of the tonsils may point beneath the angle of the maxilla, in the same manner that the supra-hyoid fascia forces collections into the sterno-pyrotidean depression, when they cannot reach the side of the chin. Its elasticity, also, allows the amygdalæ, when swollen, to be easily felt within the stylo-maxillary ligament. Properly speaking, there is no *skeleton* in the supra-hyoid region, the only bones which appertain to it being the os hyoides, and the inferior half of the internal surface of the maxillary bone. The former, nearly rudimentary in man, whilst in other vertebrated animals it forms a very complicated bone, is sometimes prolonged as far as the styloid process, from the stylo-hyoid ligament becoming ossified. Its lesser cornua, formed, generally, of several minute portions of bone, is very useful in pointing out the maxillary and lingual arteries, which, with the other deep vessels, it protects.

Notwithstanding the absence of support, and its great mobility, the os hyoides may be fractured; it has also been considered susceptible of luxation, but the evidence adduced is far from conclusive.

Transverse wounds above the os hyoides are extremely dangerous, independent of hemorrhage, as this bone gives attachment to nearly all the depressor muscles of the tongue and jaw, and nearly all the elevators of the larynx. It may be as well to remark, that a wound of this nature, above the epiglottis, would not lead to danger, as regards respiration.

The second portion of the skeleton presents the *genal process*, for the attachment of the genio-glossus and genio-hyoid muscles; the *sub-genal fossa* for the digastric; the *sublingual depression* for the gland of that name; the *sub-maxillary fossa*, prolonged as far as the angle; and, more superiorly, the *mylohyoid crest*. Forming a solid wall, it causes the various organs, sustained in addition by the cervical fascia, to project in swelling, into the mouth, rather than beneath the chin.

We may conclude, from the preceding remarks, that wounds of the sub-maxillary region are, in general, more dangerous, as they approach its extremities. In fact, an instrument cannot here penetrate at all deeply, without running the risk of wounding the facial or lingual, and one of the carotid arteries, or the internal jugular vein, the lingual, pneumogastric, or great sympathetic nerves. More deeply it would enter the pharynx. In the median line the danger is much less, as there the arteries are smaller.

The *relative position* of parts is as follows: —

1. The skin.
2. Dense cellular tissue.
3. Platisma myoides muscle.
4. Lamellous cellular tissue, in which the superficial nerves ramify.
5. Aponeurosis.
6. Digastric, stylo and mylo hyoid muscles, sub-maxillary gland, facial artery, and collateral vein, lymphatic glands, a small portion of the lingual artery, the sub-mental and lingual nerves.
7. The genio-glossus muscle, whartonian duct, hyo-glossus muscle, lingual artery, gustatory nerve, carotid arteries, internal jugular vein, and the nerves situated behind the latter vessels.
8. The genio-glossus muscle and the tongue.
9. Finally, the mouth superiorly, and the pharynx posteriorly, and internally.

Hence we perceive, that by making an incision in the median line, it would be possible to apply a double ligature round the base of the tongue, for the removal of cancers, &c.

Sub-hyoid region.—Limited on either side by the sterno-mastoid muscles, inferiorly by the supra-sternal depression, the

sub-hyoid portion of the neck represents a sufficiently regular triangle, with its base at the os hyoides. In the median line we observe, 1st, An horizontal semicircular depression, corresponding to the thyro-hyoid membrane. This is the part usually divided by suicides. 2dly, The eminence formed by the thyroid cartilage, more prominent in man than in females and children. 3dly, A depression, indicating the crico-thyroid ligament. 4thly, The projection of the cricoid cartilage, and after it, another less marked, determining the height of the trachea. 5thly, Finally, the sub-thyroid depression, deeply excavated in thin subjects, and scarcely visible in stout individuals. In a middle-sized man, when the head is slightly turned back, it measures six inches from the os hyoides to the sternum, and two and a half from the former to the fissure of the thyroid gland. There are equally two inches and a half between the lower border of this gland and the sternum. Inferiorly, the two sterno-mastoid muscles are separated from each other by a space of an inch only, whilst above there is a distance of three inches between them.

The *skin* presents nearly the same characters as in the supra-hyoid region; but being thinner, and enclosing fewer sebaceous follicles, it is more elastic.

The *subcutaneous layer* consists of three laminæ, thick and resistant, forming the *fascia superficialis* in the median line; it is thin, and less distinct, on either side, in consequence of the platisma being contained between its laminæ.

The *aponeurosis* *, continuous, superiorly, with that of the preceding, passes, externally, into the supra-clavicular region, and becomes attached below to the sternum. Its external surface is in contact with the *fascia superficialis*. Its internal, or posterior, is extremely complicated. To facilitate its description, we may examine it from above, downwards, afterwards tracing it laterally from the median line.

Attached to the os hyoides, it remains single as far as the upper portion of the thyroid gland, which it invests, forming a kind of sac, the two portions of which immediately approach each other, becoming a sheath for the thyroid veins. More inferiorly, these lamellæ are lost, the one on the anterior, and the other on the posterior surface of the sternum. The separation at this point, being filled merely by cellulo-adipose tissue, renders the sternal excavation more or less deep. Abscesses of this situation should be opened early, lest they burst through its posterior wall. Its deep layer becomes doubled, constituting the sheaths for the thyroid vessels, and enters the thorax, where we shall find it continuous with the pericardium. Laterally, the cervical aponeurosis forms as many sheaths as there are muscles, nerves, and vessels. The sterno-hyoid, sterno-thyroid,

* This is the deep cervical fascia.

omo-hyoid, sterno-mastoid muscles, the carotid artery, internal jugular vein, great sympathetic and eighth pair of nerves, thus severally receive a kind of canal. It also envelopes the trachea, passes behind the pharynx, is reflected over the anterior recti of the head, and longus-colli muscles, and is attached to the transverse processes. It next embraces the anterior scalenus muscle, and becomes continuous, on the one hand, with the external layer, which joins it behind the sterno-mastoid muscle, and on the other, by the lamellæ and aponeurosis of the supra-clavicular region.

It is, doubtless, in consequence of this lamellous disposition, that the *fascia cervicalis* has rarely been described as an aponeurosis; nevertheless, in a great many instances, it possesses fibrous texture, especially in old and thin subjects. All anatomists, moreover, as well as surgeons, were in the habit, before I described its arrangement in 1826, of saying, that the vessels, nerves, and other organs entering into the composition of the cervical region, were united by dense elastic cellular tissue, formed of lamellæ, more or less firmly adherent, one to the other. Colles and Burns had already carefully described the superficial, but they had rather neglected the deep layers. M. Blandin, who adhered to the opinion of Burns (after some modifications), has not thought proper to acquiesce in my description of this aponeurosis. There can scarcely, however, be two opinions on the subject; and in order to simplify it, I will repeat, that all the muscles, vessels, and nerves of the anterior region of the neck, the thyroid gland, the trachea, and œsophagus, are each enveloped in a fibro-cellular sheath; that these sheaths, continuous with each other, are finally attached to the common investment, or fascia cervicalis of Burns, as to a centre; and that they are also prolonged to the cellular tissue, or aponeurosis of the chest.

This disposition explains the rapidity with which abscesses form in deep-seated inflammation of the neck; why the pus burrows in different directions, instead of pointing beneath the skin; and why its inflammations almost always invade a large extent of surface. It also shows, that abscesses of the subhyoid region should be opened as soon as detected, if we would prevent their bursting into the chest. The external layer of the cervical fascia being more resistant than either of the deeper seated, causes tumours, forming beneath it, to extend backwards, rather than outwards; thus compressing the trachea, œsophagus, vessels, &c.; producing serious mischief, before they present any considerable size, externally. In operations, this should always be borne in mind, when we would expose any organ of this region. Stretched firmly across the trachea, in the supra-sternal fossa, it opposes the atmospheric pressure so completely, that its destruction may be followed by suffocation, or serious inconvenience, after the removal of tumours impli-

cating its whole substance. Its simple division, however, ordinarily produces nothing of the kind, either in common wounds, or after opening abscesses.

The *sterno-mastoid muscle* here merits particular attention. Serving as a guide in incisions, its internal margin, thin and flat in some individuals, is separated from the other muscles by a thick layer of aponeurosis. If we were ignorant of this circumstance, we might be greatly puzzled, and divide the sterno-hyoid and thyroid muscles, instead of simply everting the sterno-mastoid. I have, frequently, seen students fall into this error, whilst practising operations on the dead body.

The *sterno-hyoid* circumscribe an elongated triangle, the base inferior, in which we remark, from above downwards, beneath the aponeurosis, the middle of the thyro-hyoid membrane, the angle of the thyroid cartilage, the crico-thyroid artery and membrane, the cricoid cartilage, the union of the two lobes of the thyroid gland, thyroid veins, and the trachea. It is, consequently, in this region that *tracheotomy* is performed. The sterno-mastoid covers the lower portion of the sterno-hyoid muscle, from which it is separated by the sterno-clavicular articulation. The sterno-hyoid lying upon the sterno-thyroid muscle, in its inferior half, immediately covers the thyroid gland, cartilages of the larynx, and thyro-hyoid depression.

The *sterno-thyroid*, rather larger than the preceding, like it, circumscribes, with its fellow, a triangular space, but disposed inversely, in which we see the same parts as in the other, and in addition, superiorly, a portion of the sterno-hyoid muscle. The two sterno-thyroid muscles are divided from each other by an interval of about an inch, towards the middle of the region.

Fixed to the sternum and larynx, these four muscles form a kind of shield over the trachea; so that, if they be destroyed, this canal, pushed forwards during inspiration, may, as in the example reported by Burns, be compressed by the air fulfilling but badly its functions of respiration.

Covered, as it emerges from behind the sterno-mastoid muscle, by the external jugular vein, and a branch of the superior thyroid artery, enclosed in the *fascia cervicalis*, the *omo-hyoid* may be felt through the skin, in some individuals. Ascending towards the os hyoides, it crosses the vessels and nerves, circumscribing two triangular spaces, with which the surgeon ought to be well acquainted.

Omo-hyoid space.—One of these triangles, superior, limited by the supra-hyoid region above, and by the sterno-mastoid muscle without, may be called the *omo-hyoid triangle.* We here recognise the internal jugular vein, the descendens-noni, eighth, superior laryngeal, and great sympathetic nerves; about an inch of the primitive carotid, the origins of the internal and external

carotids, that of the facial, lingual, occipital, and, occasionally, of the inferior pharyngeal and superior thyroid arteries. Finally, we also see the thyro-hyoid muscle, a small portion of the middle and inferior constrictors, the thyroid cartilage, its superior cornua, and the lateral portion of the thyro-hyoid membrane.

Omo-tracheal space.—The other space, which may be termed *omo-tracheal triangle*, much more extensive than the preceding, limited, upwards and outwards, by the omo-hyoid muscle, outwards and below by the sterno-mastoid, and within by the trachea, encloses nearly the whole of the sterno-hyoid and thyroid muscles, a small portion of the thyro-hyoid, a lobe of the thyroid gland, and the arteries distributed to the sub-hyoid veins, the plexus of the hypo-glossus nerve, the side of the cricoid cartilage, trachea, and œsophagus, the recurrent nerve, primitive carotid and inferior thyroid arteries, great sympathetic and pneumo-gastric nerves, internal and external jugular veins, and, lastly, the vertebral arteries.

The *thyro-hyoid*, the last of the superficial muscles of this region, covered by all the others, lying upon the thyroid cartilage, are separated from the thyro-hyoid membrane by a considerable space. The laryngeal nerve lies behind their posterior border, between the os hyoides and thyroid cartilage, before it penetrates the larynx. They lead to no surgical consideration.

The *longi-colli*, a portion of the anterior *great recti muscles* of the head, situated deeply on the transverse processes and bodies of the cervical vertebræ, also appertain to the sub-hyoid region. Between the former and the scaleni, there exists a triangular space, through which the vertebral artery runs, before it enters the foramina in the transverse processes.

Arteries.—The *carotids* are those which here merit most attention.

The *right carotid*, shorter, closer to the median line, and larger than the left, in consequence of its arising from the innominata, would prevent our opening the œsophagus, on this side, and should be remembered in tracheotomy.

Anteriorly, the *left carotid* is at first separated from the sternal portion of the sterno-mastoid muscle, by an interval of about an inch, which is less on the right side, where the artery approaches nearly to the anterior border of the muscle. They are both immediately covered by the internal surface of this same muscle, and by the posterior border of the sterno-thyroid. As the sterno-mastoid passes backward in ascending, they thus become superficial at the upper part of the neck, and are, consequently, more easily tied in this situation. Posteriorly, they lie on the great sympathetic, and on the cardiac filaments, derived from this and the pneumo-gastrics, which lie in their sheaths: on the inferior thyroid artery, opposite, or a little inferior to, the omo-hyoid muscle, on the cervicalis ascendens, the vertebral and its

accompanying vein; finally, mediately, on the anterior of the base of the cervical transverse processes, and at the triangle bounded by the scalenus anticus and longus-colli muscles.

We perceive, by this arrangement, that, if necessary, the carotid may be compressed on the left side, at some distance above the sternum. In fact, nothing would prevent their compression, on both sides, in the omo-hyoid triangle, if this could be beneficial, in acute ophthalmia, and inflammation of the brain, as was supposed by Messrs. Watson and Bland. It must, however, be remembered that the pressure of the nerves cannot be supported for any length of time, without danger. Close to the sternum, they are divided from each other merely by the trachea, or in other words, by an interval of about an inch, or eighteen lines; whilst, superiorly, they have the whole of the larynx between them.

We can only reach the primitive carotid artery, on its internal side, at its inferior third, or rather by the anterior border of the sterno-mastoid muscle, in its whole extent. Externally, an instrument would only reach it, after dividing the internal jugular vein; in the other direction, on the contrary, there are no vessels of any importance. The instrument would traverse, first, the skin, parallel to the sterno-mastoid muscle, but in such a manner, that, if above, the incision should be at the internal border of the muscle, whilst, inferiorly, it were better made above it, especially on the left side; secondly, the aponeurosis and the sterno-mastoid muscle, which should be drawn outwards after the division of this *fascia;* thirdly, a thinner and very elastic layer, in which some filaments of the cervical plexus, the descendens-noni nerve, commonly ramify, and which furnishes a sheath to the omo-hyoid muscle.

This muscle crosses the carotid in such a manner, that to tie the vessel in the *omo-hyoid triangle* it should be depressed, by being carried inwards, and, on the contrary, pushed upwards and inwards, when the operation is performed in the *omo-tracheal triangle*, unless it be found advisable to cut it across.

The opening of the sheath, furnished by the aponeurosis to the artery, is one of the most delicate points in the operation. Too externally, we run the risk of opening the jugular vein; directly in front, we may injure the carotid itself. However, if the sheath be not divided, the descendens-noni and cardiac nerves, adhering more or less to the external surface of the artery, would inevitably be comprehended in the ligature.

Ligature of the primitive carotids for aneurism, wounds, or any diseases of their branches, should be applied to the omo-hyoid region, as there the space is larger, and the vessels more superficial. When, on the contrary, aneurism occupies the trunk, we are obliged to place the ligature nearer to the sternum. In this case, the operation, more easily performed on the right side, is also more dangerous there, from the approximation of

the subclavian artery, preventing the formation of coagulum in the origin of the carotid. It is true, that in cutting on the *sterno-clavicular depression*, as recommended by M. Sedillot, we should come directly upon the vessel; but, then, the muscular fibres being spread, would, it appears to me, present an important obstacle.

The division of the common carotid occurring opposite the superior border of the thyroid cartilage, the sub-hyoid region encloses about an inch of the internal and external carotids. The *external*, which would be better termed *superficial*, is placed in front of, and even a little within, the internal, which is larger, and lies on the anterior of the spine. A ligature should not be applied upon them at a point so close to their origin. In cases appearing to require it, the same operation performed on the common trunk should always be preferred, perhaps adding, as I once did, for a tumour in the temple, a ligature on the internal carotid, thus moderating, as much as possible, the reflux of the blood. Before it enters the supra-hyoid region, the external carotid generally furnishes the superior thyroid, external maxillary (*facial*), lingual, inferior pharyngeal, and occipital.

Separating from the trunk opposite, or a little beneath the cornua of the os hyoides, the *thyroid*, to reach the superior and external portion of the thyroid gland, follows a tortuous direction; but generally, obliquely, forwards and downwards. Enveloped in the deep layers of the *fascia cervicalis*, covered slightly by the sterno-mastoid, cellular tissue, subcutaneous layer, and skin, it is crossed by the lingual, whilst it passes over the superior laryngeal and several filaments of the great sympathetic nerves. In this course it gives off the hyoid branch, distributed to the thyro-hyoid membrane, following the inferior border of the bone, and frequently wounded in attempts at suicide. It furnishes a second, which descends behind the gland, internal and anterior to the carotid sheath; this should be pushed towards the trachea, when the principal artery of the neck is secured at this point. A third, the laryngeal, ramifies between the contrictors of the pharynx and posterior border of the thyro-hyoid muscle, on the membrane of the same name, and is lost in the larynx.

From this arrangement, the trunk of the superior thyroid can easily be exposed and secured, in the course of a line drawn from the cornua of the os hyoides, to the anterior and inferior portion of the thyroid cartilage, or rather by carrying the incision obliquely, downwards and outwards, from the hyoid bone to the sterno-mastoid muscle, or, finally, by dividing the soft parts parallel to this muscle in the omo-hyoid triangle. The artery, before arriving at the gland, is, in fact, merely covered by the cervical branch of the ninth pair of nerves, some veins, the aponeurosis, and common integuments.

We also remark two other arteries of considerable size, the *inferior thyroid* and the *vertebral.*

Placed, at first, behind the common carotid and internal jugular vein, the pneumo-gastric and great sympathetic nerves, in front of the scalenus and longus-colli muscles, the *inferior thyroid artery* ascends tortuously, behind the thyroid gland, where it terminates, by giving off a large number of branches, which anastomose with those of the opposite side, and the superior thyroid. On the left side, when very deeply seated behind the carotid, it may lie behind the thoracic duct, at the same time approaching nearer to the œsophagus than it does on the right. Anteriorly and externally, it is crossed by the cervical branch of the lingual nerve. The inferior laryngeal lies internal and posterior to it.

This artery is nearly always met with in the upper part of the *omo-tracheal* triangle, in the direction of the omo-hyoid muscle, behind which it occasionally lies. It may be tied without difficulty by pursuing the same steps as for the carotid; only the sheath of the latter, instead of being opened, must be pushed outwards, whilst the thyroid gland and trachea are drawn inwards, and the omo-hyoid muscle upwards. The vessel is always found in this space close to the muscles.

It should, however, be noted, that the thyroid arteries do not always present either the same size, origin, or distribution. I have seen the superior of the left side exceed the size of a quill, whilst the right was smaller than usual.

In three subjects I found it arose from the primitive carotid. It very frequently runs to the front of the larynx before it divides, and Roberts has well described the dangers of this distribution, with regard to tracheotomy. The inferior is sometimes wanting, at others it passes before the carotid to the gland. Burns relates a case in which both arose from the right side; consequently, the left was obliged to cross the trachea before it could reach its destination.

There occasionally exists a fifth thyroid artery on the median line, described, in the first instance, by Neubauer, in 1772, and since that period, by nearly all anatomists. It sometimes arises from the innominata, but more frequently from the arch of the aorta, ascending, in a tortuous manner, to the inferior portion of the gland, anterior to the trachea, behind the veins, aponeurosis, and skin. M. Lauth informed me, that he once saw it given off by the internal mammary. This would add considerably to the danger of tracheotomy, as a ligature cannot be applied upon it without considerable difficulty, in consequence of the large veins usually covering it.

It should, moreover, be understood, that this artery, termed *middle thyroid* by Harrison, varies considerably as to size, position, and even number; there being occasionally two. In the

case related by Meckel, arising from the innominata, it ran to the left lobe of the gland, directly upon the anterior surface of the trachea; in such a manner that it must inevitably have been wounded, had tracheotomy been attempted. Burns mentions a similar instance; but Roberts is in error when he says, that œsophagotomy was performed on this individual.

The *vertebral* also arises from the subclavian. Crossing behind, and covered by the internal jugular vein and carotid artery from below, upwards and inwards, it, in some individuals, slightly overlaps the internal portion of the common carotid. The great sympathetic and eighth pair of nerves pass over it in the same direction, being internal to it inferiorly, and external superiorly. It is accompanied, on its inner side, by the longus-colli muscle; afterwards by the inferior laryngeal nerve, the œsophagus, and trachea. Externally, it is in relation with the middle cervical ganglion and its filaments, the phrenic nerve, and anterior scalenus muscle, and finally enters the canal formed by the foramina of the cervical transverse processes, through which it runs to the cranium. If it can be tied with any advantage, as Hippolyte of Naples asserts, it is behind the primitive carotid, towards the inferior portion of the omo-tracheal triangle.

Some of these arteries present still other *anomalies*. The two carotids, sometimes, arise from a single trunk, which I have seen extend as far as two inches above the sternum. Burns, who cited five cases of this description, also described one in which the innominata reached the inferior border of the thyroid gland. Tracheotomy and œsophagotomy, although under these circumstances exceedingly dangerous inferiorly, would still be practicable superiorly: but when the right carotid, as I have seen in three instances, rising from the aorta, crosses the trachea to its natural position, or when that of the left side arises from the innominata, the operation would, of course, be attended with excessive danger, and it was most likely some such variety which caused the death of the young female mentioned by Walter, as having perished from the artery being wounded during the operation for tracheotomy.

The carotid, instead of bifurcating in its ordinary situation, occasionally divides at the base of the neck, or, in other instances, remains entire as far as the angle of the jaw. These irregularities place the surgeon under great embarrassment, should he attempt to operate for aneurism, &c.

Nothing is more common than to find the vertebral arteries arising from the transverse portion of the aorta, instead of the subclavian, especially on the left side. Frequently also, on one side, or even on both, they do not enter the canal until very high up in the neck, opposite the fifth, fourth, second, or first cervical vertebræ. Under such circumstances, aneurism of the vertebræ would resemble that of the carotid; the one might thus

be mistaken for the other; or, both being included in the same ligature, one side of the brain would suddenly be deprived of blood.*

Veins.—The internal jugular, lying external to the carotid, follows the same course as that artery. Notwithstanding these two vessels are enveloped in a common fibrous sheath, they have each their proper cellular membrane. We distinguish the vein from the artery by the thinness and transparency of its coats, by its position, always external, and by the colour of the blood circulating through it. It is commonly flattened in the dead body, forming a half canal, placed on the external portion of the carotid. During life, its relative size being much greater, it covers a considerable portion of the anterior surface of the artery. Dilating during expiration, it is largest in those cases where inspiration is most interrupted. These variations in size especially interfere in the application of the ligature upon the carotid. This, however, may be prevented by compressing the vein at the upper portion of the neck. Covered by the same parts as the artery, accompanied externally by the phrenic nerve, and generally by the cervical plexus, the jugular vein touches the carotid, thus accounting for some of the varicose aneurisms of the neck. Posteriorly, it crosses the inferior thyroid artery, and the branches of the cervical plexus, which anastomose superiorly with the great sympathetic. In the latter situation, it ordinarily covers the arteria cervicalis ascendens, and lies on the internal side of the scalenus anticus muscle, commonly hiding the vertebral artery in entering the subclavian vein. Its anterior portion receives numerous veins, crossing the common carotid, and impede the more in operations, in that they are very uncertain as to number, size, and position. All, however, appertaining to the organs situated in the supra and sub-hyoid regions, they are more especially collected, on the one hand, beneath the cornua of the os hyoides, and on the other, in the base of the region above the sterno-clavicular articulation. There are also some large venous branches ramifying in the supra-clavicular region, from the anterior portion of the chest, particularly on the left side, emptying themselves into the subclavian or internal jugular. The plexus, thus formed, may add considerably to the difficulty of applying a ligature on the subclavian artery, internal, to the sterno-mastoid muscle, and accordingly it is much easier, in these cases, to tie the carotid immediately above or below the omo-hyoid muscle.

The *external jugular* commonly belongs to the supra-clavicular region; we, however, sometimes meet with it in the sub-hyoid; in these instances it is smaller than ordinary. It occasionally receives most of the branches of the face and sub-maxillary region; now-and-then, on the contrary, it appears formed solely of thyroid

* This is not the case, as the brain would then be supplied from the internal carotid and vertebral artery of the opposite side, through the free anastomosis, at the circle of Willis.

branches, wandering from their natural direction. Its trunk, on some occasions, empties itself into the internal jugular, close to the larynx; but it more frequently descends, isolated, to the lower part of the neck, then entering the same vessel; and, upon other occasions, it runs directly into the subclavian, especially on the left side. Placed superficially, it ramifies between the muscles and the fascia cervicalis, which it traverses in an especial manner, when proceeding from the thyroid gland.

The *thyroids* are larger, in proportion, in the infant than the adult, and in the female than the male. Their size commonly depends upon that of the gland, and they may be arranged in two divisions. Those accompanying their arteries are more superficial, crossing the carotids to the internal jugular. The others, uniting beneath the gland, form three, four, or five principal branches, which, descending in front of the trachea, constitute a species of plexus between the sterno-hyoid and thyroid muscles. This is the *sub-thyroid plexus*, which adds so much to the danger of *tracheotomy*. Its branches, enveloped in cellular tissue, and a process of the deep cervical fascia, empty themselves into the subclavian vein. Being also situated beneath the aponeurosis, they are not visible, even in cases of varicose dilatation.

The *other veins* pass into one of the preceding branches, and are scarcely worthy further notice. The *facial* and *lingual*, crossing the carotid superiorly, have been already mentioned.

The *anomalies of the veins* of the neck are important. Where there are several external jugulars, they are so minute that phlebotomy is performed with difficulty. In the varieties cited by Wild, the enormous branch, which on each side communicated the jugulars with the thyroid plexus, would greatly increase the dangers and difficulties of tracheotomy and œsophagotomy. Close to the heart, and having no valves, they allow the reflux of blood, in such quantities, that the opening of a single external jugular vein, has led to fatal hemorrhage. For the same reason, their inflammation is quickly fatal. This reflux is so manifest here, in several diseases, that we may see pulsations in the suprasternal fossa, and along the sterno-parotidean fissure, as we shall also observe in the supra-clavicular regions.

The *lymphatics* are numerous, and pretty well understood. Some descend to the mediastinum, others to the axilla; but the greatest proportion terminate beneath the sterno-mastoid muscle. Their *glands* should be well understood, on account of the numerous diseases to which they are subject. They form, at first, a remarkable chain, round the carotid and internal jugular vein. Some others, less voluminous, are situated anterior to the trachea, behind the sub-thyroid plexus. We occasionally find one in front of the larynx. In swelling, these glands may assimilate various diseases. The slow and gradual developement may lead to the suspicion of aneurism, either of the carotid, its branches, or the inferior thyroid. This error is the more difficult

to avoid, inasmuch as the folds of the cervical fascia and the sterno-mastoid muscle present so much resistance, in some individuals, that, re-acting posteriorly on the vessels, they thus interrupt the circulation. The same may be said of the glands in front of the trachea, with regard to the thyroid, as this gland has more than once been considered to be removed, when the surgeon had simply extirpated one of those surrounding it. The gland described by Burns is equally likely to acquire large size, to give rise to many errors, and to produce disastrous results. Finally, there are some, very small, met with between the œsophagus and trachea, surrounding the recurrent nerves. Their depth would render diagnosis of their pathological condition more difficult than that of the preceding.

The *nerves* are very numerous.

The *cervical plexus* furnishes the superficial and deep. The former, appertaining to the branches ascending towards the larynx, beneath the chin, between the fascia and platisma, are flattened, hard, and necessarily divided in ligature of the carotid in the *omo-hyoid* triangle. Their anastomosis with the facial accounts for the sometimes exceedingly acute pain, arising in the face from subcutaneous tumours of the neck. The latter are filaments of communication with the great sympathetic, and especially the branch anastomosing with the ninth pair. Emerging from beneath the sterno-mastoid muscle, this branch crosses the anterior of the jugular vein very obliquely before it unites with the filaments of the hypo-glossal. Other branches of the cervical plexus pass behind the deep vessels of the neck.

We next find the *descending branch* of the ninth. Given off from the trunk, opposite the os hyoides, it at first lies without the internal carotid; afterwards, in front of the common carotid, to which it is, as it were, attached. It sometimes abandons this vessel, to approach nearer to the larynx or trachea, but more commonly to run externally on the jugular vein. It unites, near the omo-hyoid muscle, to the internal descending branch of the cervical plexus, in such a manner, that in some individuals it forms externally, or beneath, a kind of plexus, named by some authors, *superficial cervical plexus*, the filaments of which, at first, cover the primitive carotid artery, in the *omo-tracheal* triangle.

The *pneumo-gastric*, the largest and most remarkable of all the nerves of the neck, placed on the base of the cervical transverse processes, is, at the same time, covered by the carotid artery and internal jugular vein. It is, therefore, between these vessels that we constantly find it close to the great sympathetic nerve. In this situation, it cannot be mistaken for any other organ, and is enveloped by very dense cellular tissue.

The pneumo-gastric gives off two principal branches, the two *laryngeal* nerves.

The *superior laryngeal*, separated from the trunk of the eighth pair, opposite the os hyoides, at first lies behind the carotid, close

to its division. It next runs internally, to arrive, on the one hand, at the posterior portion of the thyroid gland, and, on the other, on the thyro-hyoid membrane. Sometimes more, sometimes less elevated than the superior thyroid artery, it is always more deeply seated, although it follows nearly the same direction. Its division almost inevitably produces dumbness.

Longer on the left side than on the right, because, in the former, it passes beneath the arch of the aorta, whilst, in the latter, it hooks round the subclavian, the inferior, or *recurrent nerve* ascends to the larynx, between the carotid lying externally, and the œsophagus and trachea internally. At first, closer to the artery, the nerve quickly approaches nearer the respiratory and alimentary tubes, to which it supplies numerous branches. It consequently follows, that the inferior laryngeal nerve, exposed to injury in *œsophagotomy*, may likewise be wounded in extirpation of the thyroid gland, ligature of the inferior thyroid artery, of the common carotid inferiorly, and of the subclavian internal to the sterno-mastoid muscle.

In a case mentioned by Hart, the right recurrent was wanting, being replaced by some other sub-hyoid branch, which must inevitably have been wounded in œsophagotomy. In another, mentioned by Wrisberg, there were two on each side.

We must also note the *cardiac filaments* furnished by the eighth pair. More numerous on the left than on the right side, they remain for some distance behind the trunk of the carotid, adhering, in fact, to the sheath, especially at their upper half. This sheath should, therefore, be opened in tying the carotid, otherwise one or two might be implicated in the ligature, interrupting the action of the heart. Placed more deeply than the pneumo-gastric, the *great* sympathetic is equally covered by the carotid artery. We also find in this region a portion of its superior, and (when it exists) the whole of its middle ganglion, the two cardiac nerves, and numerous accessory filaments.

SECTION SECOND.

LARYNGO-TRACHEAL REGION.

Situated in the median line, the *laryngo-tracheal canal* presents relations common to all the parts composing it, which also offer individual peculiarities. It is covered anteriorly, through its whole extent, by a double layer of the cervical fascia, by the subcutaneous tissues, and, more externally, by the sterno-hyoid muscles, aponeurosis, platisma, and skin; more deeply, the carotid arteries, the pneumo-gastric, and great sympathetic nerves, with the jugular vein accompanying it through its whole course. Its different portions have special relations, and must be examined separately.

The *thyro-hyoid membrane*, similar in nature to the yellow ligaments, is separated from the epiglottis, posteriorly, by a triangular space, filled with adipose cells, or by the epiglottidean gland, and from the pharynx, by mucous membrane. Anteriorly, it is covered by an arterial branch, and some small twigs, derived from the superior thyroid; by the superior laryngeal nerve, which pierces it to enter the larynx, with some filaments from the lingual; by a cellular layer, lodging the vessels and nerves; by the omo, sterno, and thyro hyoid muscles; and, finally, by the aponeurosis, platisma, and skin. Its length is about fifteen lines, thicker in the centre than laterally. Instruments dividing it transversely, or otherwise, are liable to penetrate the pharynx, beneath the epiglottis. Provided the glottis remains uninjured, wounds do not necessarily produce dumbness, since the voice is incontestably formed beneath; but they may produce serious mischief, from dividing the laryngeal nerve and thyro-hyoid artery. Being more constricted than the os hyoides and thyroid cartilage, it forms a kind of fissure into which instruments of destruction are commonly introduced in attempts at suicide: they are generally, however, arrested by the cornua of the thyroid cartilage.

As there are no organs of importance likely to be wounded, the epiglottis being placed posteriorly, M. Vidal (de Cossio), considering that quinsy generally proceeds from an accumulation of pus, either in the substance of the cordæ vocales, or between the epiglottis and os hyoides, proposed to penetrate this cavity, and give exit to the fluid. M. Malgaigne, also, recommended the same method for the abstraction of foreign bodies arrested in the ventricles of the larynx.

The *larynx* offers to our consideration, in the first place, the *thyroid cartilage*; next, the *cricoid*; finally, the crico-thyroid membrane. The former, harder and more disposed to ossify than the second, forms a slanting prominence on its superior border, projecting strongly upwards, especially in man. In this respect the difference between the two sexes is so great, that, to distinguish them, it would be sufficient to touch the larynx in the adult. It is nearly an inch in length. Its external surface forms two planes, inclining backwards; its internal presents two other planes, inclosing the essential portions of the larynx. The *cordæ vocales* are attached by their anterior extremity, in the retiring angle resulting from their union, at about two lines beneath the superior median fissure; and, a little inferiorly, we find the thyro-arytenoid muscle. Thus, in *laryngotomy*, according to Desault's mode, the division must be made directly on the median line.

The *cricoid cartilage*, largest posteriorly, is there surmounted by the two arytenoids, with which it so articulates, that in my opinion, they may bend either forwards or laterally. Posteriorly, it is covered by the posterior and lateral crico-arytenoid muscles. It next corresponds to the origin of the œsophagus, or, rather, to

the termination of the pharynx. On its sides are the crico-thyroid muscles, whilst, anteriorly, there are no organs of importance, the thyroid gland rarely reaching so high up. Opposite to it, the trunk of the recurrent nerve is lost in the tissues, in the same way that the superior laryngeal spreads out above the thyroid cartilage. The proper muscles of the larynx receive the latter filaments of these nerves, but their exact point of termination has not yet been discovered. According to Magendie, there is one nerve for the dilating muscles, and another for the constrictor of the glottis; but, like M. Blandin, I have frequently traced a filament of the recurrent as far as the arytenoid muscles.

The *crico-thyroid membrane*, from four to five lines in its transverse, and from three to four in its vertical diameter, is of the same nature as, although much stronger than, the thyro-hyoid membrane. Destined simply to fill up the space between the cricoid and thyroid cartilages, it is capable of being folded, on itself, in their various movements. No important organ crosses it anteriorly, excepting the crico-thyroid artery. In exposing it, the parts divided are, the skin, superficial fascia, aponeurosis, and several layers of cellular tissue, assembled in the median line, after having enveloped the muscles.

The *cricoid artery*, nearly always forming an arch, may give rise to alarming hemorrhage: on the one hand, because it is difficult to arrest the blood by pressure; on the other, because this fluid may flow into the opened larynx, producing symptoms of suffocation. To avoid such an accident, we must vary our methods of proceeding. When we would open the crico-thyroid membrane simply for the admission of air, we should divide the tissue, parellel to the direction of the artery, which may then be either depressed or raised by the finger nail. When, on the contrary, we operate for the extraction of a foreign substance, this substance may be either above or below the cricoid cartilage. In the former case, we may be obliged to follow the advice of Desault, and divide the thyroid cartilage, from below upwards; and we must then, before perforating the membrane, assure ourselves of the precise size and situation of the artery. If the finger does not discover it, does not feel its pulsation, we may be certain that it is too small to cause danger by its division. If, on the contrary, its pulsation is very distinct, if, in a word, it is of any size, we should draw it down, and commence our incision above it. In the latter, or where the foreign substance is below the cricoid cartilage, we should, as recommended by Boyer, cut through this cartilage from above, downwards. The artery, in this case, when of any size, frequently furnishes a descending branch, which it would be impossible to avoid in cutting transversely beneath the thyroid cartilage. Could we be aware of this fact beforehand, we might avoid it with certainty, by cutting the cartilage laterally, as was proposed by M. Foulhioux, for the purpose of avoiding the cordæ vocales. We must recol-

lect, moreover, that, in this situation, the trachea is only about seven lines in diameter, and we should, consequently, be careful not to injure the opposite wall with the knife. We had, therefore, better use a probe-pointed bistouri; and, if we employ a canula, it ought to be short, and curved, so that its extremity may remain free in the canal.

The two excavations or *ventricles*, presented by the interior of the larynx, explain why foreign bodies stop here so frequently, instead of descending into it; and the depressions, observed above the superior cordæ vocales, are also obstacles which they do not always overcome.

The superficial position of the larynx, it is true, renders its incision easy, and but little dangerous; but, besides the possibility of these cartilages becoming ossified, we can only open, according to the methods of Desault or Foulhioux, for the extraction of foreign bodies; for, if we would re-establish respiration, neither the process of Vicq-d'Azir, nor that of Boyer, would allow of a sufficiently large opening for the maintenance of a proper-sized canula.

The *trachea* reposes, by its membranous portion or posterior fourth, upon the œsophagus, which, being attached to it by loose cellular tissue, explains how foreign bodies, arrested in either of these canals, may penetrate the other. It is enveloped, anteriorly and laterally, by the thyroid gland. Although the functions of this latter organ are not well understood, it, nevertheless, occupies a marked situation in surgery: in the first place, from the diseases to which it is exposed; and, in the second, on account of its complex relations.

The *thyroid* is enveloped in a species of fibro-cellular bag, occasionally very dense, rendering fluctuation of its interior very difficult to be ascertained, when pus and other fluids accumulate; and allowing the gland to attain considerable size, without contracting firm adhesion with the surrounding tissues. The two lobes forming it are sometimes almost separated. When the isthmus uniting them is situated at its inferior portion, it leaves the larynx, with three or four rings of the trachea, perfectly exposed, and allows of laryngotomy or tracheotomy being performed with facility. In other cases, its two portions are united, for nearly the whole extent of their internal border. The trachea, in this case, is completely hidden by the gland, from the larynx as far as the fifth, sixth, and sometimes even the seventh ring. In front, the gland is covered by the anterior portion of its capsule, by the sterno thyroid and hyoid muscles, by the common integuments, and frequently by a peculiar fleshy ribbon, which appears suspended to the os hyoides. Posteriorly, it is grooved, for the reception of the commencement of the trachea, from which it is merely separated by cellular tissue and its own proper sheath. Laterally, it reposes on the inferior laryngeal nerves, slightly on the œsophagus to the left side, on the

primitive carotid, and principal branches of the thyroid arteries.

Its tumours, retained by the cervical aponeurosis and muscles, sometimes carried backwards, compress the trachea, and other organs found in this region, producing serious mischief. We may readily understand the difficulties attending the operation for removal of this gland. The inevitable division of the four or five thyroid arteries would give rise to considerable hemorrhage; the veins, also, would increase the flow of blood, and the air, being introduced into their orifices, might, as has been said, cause instant death. It must not be forgotten, in addition, that the thyroid gland, in a pathological condition requiring extirpation, has acquired a size causing marked dilatation of all its vessels; as in the case cited by M. Hedenus, where he had to tie forty-two vessels during the operation. It often, also, extends so much outwards, and is so intimately united with the organs placed behind it, that it is difficult to avoid the trachea, the carotid artery, and the internal jugular vein. Notwithstanding the unfavourable tendency of these circumstances, the operation has been practised with success on numerous individuals; and M. Hedenus relates six cases of goître, in which he perfectly succeeded.

Provided with a firm fibrous envelope, we may conceive that the thyroid gland may be transformed into a cyst; and that, consequently, surgeons have been in the habit of employing remedies for hydrocele. Its redness and homogeneous structure explain its scrofulous and hydated degeneracies, and why scirrous tubercles, abscesses, and calcareous concretions may be developed.

Beneath the thyroid gland, the trachea corresponding to the supra-sternal fossa of the sub-hyoid region, is covered by lamellous and filamentous cellular tissue, containing a quantity of adipose vesicles, and sometimes by one or more lymphatic glands, which, in swelling, would produce considerable interruption to the respiratory and digestive functions. When diseased, these glands may resemble aneurism of the commencement of the carotids and subclavian arteries, or be mistaken for a pathological developement of the thymus gland, which, in the infant, naturally ascends a little into the supra-sternal space. On the other hand, the cellular tissue is sometimes the seat of acute or chronic inflammation, terminating in suppuration. The abscesses resulting are generally recognized with difficulty, in consequence of the aponeurosis behind which they are placed. It is, besides, very essential that these should be opened early, as they soon spread into the thorax.

We next find, proceeding from the deep-seated parts towards the skin, the inferior thyroid veins; the artery of the same name, when it exists; the thick aponeurosis; finally, the cellulo-adipose layer. The veins, naturally very large, are still more consider-

able in goître, and the other alterations of the thyroid gland. To avoid the accident, which would undoubtedly prove fatal, we should cut at least three rings of the trachea, in such a manner, in short, that the expiration forces the blood out with violence; especially as there is no danger in making a large opening in the canal.

When the middle thyroid artery exists, it is situated behind the veins, and most commonly a little to the right; it may there be distinguished by its pulsation, the thickness of its walls, and the distribution of its branches.

More externally, the relations of the trachea are not quite the same on the left as on the right side; 'the aponeurosis and sterno thyroid and hyoid muscles, cover it equally on both, but the primitive carotid, more anterior and superficial, approaches nearer on the right than on the left. If, during tracheotomy, the trachea were to slip only a few lines to the right, the knife might wound the arteria innominata, an accident which happened to a student of medicine in his endeavours to relieve a friend suffering from asphyxia. The prolongation of the trunk of the innominata, on which Harrison insists with so much reason, and the other varieties, in the origin of the carotids, mentioned above, sufficiently account for this accident, as for that of the young woman mentioned by Walter.

We cannot be too much upon our guard against the mobility of the trachea. This mobility interferes principally in simple puncture, as, whether we use the trocar or the point of a bistouri, the organ is always likely to slip from beneath the instrument. There is another reason, also, against using sharp-pointed instruments in tracheotomy. A simple puncture, merely serving to admit the air into the lungs, it is always more certain and easier to make an opening between the two cartilages of the larynx than on the trachea. In croup, as for the extraction of any foreign substance, we should make a vertical incision through several of the rings, as mere punctures are insufficient, and we must besides remark, that in dividing the tissues, parallel to the trachea, it is much easier to separate the vessels from it. Independent of anomalies, its opening is not, after all, very dangerous. By making a free incision at once, the respiration is re-established, the wounded veins cease to bleed, and the arteries may be tied, if necessary.

Whether it be for a foreign substance, or merely to restore respiration, its division can scarcely be too large; and I have proved, after M. Bretonneau, that the canula introduced will but imperfectly perform its office, if it be less than half the diameter of the wind-pipe. It now only remains to observe, that an opening made beneath the thyroid cartilage, inevitably destroys the voice, in consequence of sounds being formed in the glottis. Numerous experiments on dogs, and observations on man, have proved this point of physiology.

The air, continually traversing the trachea, renders the union of wounds with loss of substance very difficult, giving them a certain tendency to remain fistulous.

Œsophagus, a mere continuation of the pharynx, commences opposite the fourth cervical vertebræ. Its superior portion is sometimes comprised in the sub-hyoid region, and occasionally terminates in a cul-de-sac, at some lines beneath the larynx. Placed, at first, in the median line behind the cricoid cartilage, it immediately inclines slightly to the left side, passing a few lines beyond the trachea in this direction. Reposing on the bodies of the vertebræ, it may participate in their diseases, subsequently communicating them to the trachea, a circumstance which frequently occurs. Firmly attached to the posterior portion of this canal, it is partly hidden by it on the right side, and accompanied by the inferior laryngeal nerve, afterwards by the carotid. On the left side, the thyroid gland covers it more immediately; it is crossed by the inferior thyroid artery; the recurrent nerve, lying nearer the front than on the right side, is more easily wounded anteriorly. The carotid is also closer, as, on the right side, the œsophagus is almost entirely covered by the trachea. In consequence of this anatomical arrangement, it has been proposed, as a general rule, to practise œsophagotomy on the left side, and, as much as possible, between the thyroid gland and the sternum. We arrive on the organ at this point, by cutting as for the ligature of the carotid. Having pushed the artery externally, and the sterno-thyroid muscle towards the median line, we come upon a thick layer of fibro-cellular tissue. When this is divided, the canal is exposed, and we complete the operation, taking care to avoid the recurrent nerve and the trachea.

Among the anatomical variations, increasing the danger of this operation, we must not forget that of the right carotid artery, rising from the left, or from the summit of the chest, and passing between the œsophagus and the vertebræ or the trachea, as has been observed in the cases which I will enumerate in speaking of the supra-clavicular region.

Although surgeons have maintained silence upon this point, foreign bodies should rarely be extracted at the lower portion of the œsophagus, if their size alone prevents their entering the stomach; as, having once passed the commencement of this organ, and continued beyond the cricoid cartilage, there does not appear to be any obstacle to their further progress. It is, therefore, opposite the inferior portion of the larynx, that we are most frequently called upon to perform œsophagotomy. The operation is then much more dangerous and difficult, both on account of the thyroid gland and its arteries, and because the organ is more deeply seated. In all these cases, the instruments invented by Vacca, Berlinghierri, or that of Dupuytren, would remove great part of the difficulty.

4

Skeleton.—The sub-hyoid region has no proper skeleton pertaining to it. It lies on the bodies of the four last cervical vertebræ, forming a convexity at this point.

Remarks.—At no other part of the body do we find so many objects united in so small a space, neither are diseases, operations, &c. more dangerous in any other region. In consequence of the attachment of the œsophagus to the trachea, foreign bodies frequently pass from one of these canals into the other, or, traversing both, perforate either the carotid, the subclavian, or even the aorta itself, or some of the corresponding veins, giving rise to hemorrhage, which is soon fatal. The escape of air, following lacerations of the one, explains the emphysema occasionally seen in the neck, and extending over the whole body, in the same manner as the food, escaping from the other, quickly produces violent inflammation, abscess, or suffocation, when, as in the case mentioned by M. Gendron, it passes into the trachea.

The chest preventing the arteries of the neck being exposed, beneath aneurisms occupying their inferior portions, surgeons, remarking that the carotid gives off no branch before its bifurcation, opposite the os hyoides, have placed the ligature above the tumour. This operation, performed once in France, and several times in England and America, has been attended with unlooked-for success.

SECTION THIRD.

SUPRA-CLAVICULAR REGION.

Circumscribed, anteriorly, by the sub-hyoid, sub-maxillary, and parotid regions; posteriorly, by the edge of the trapezius; inferiorly, by the clavicle and the first rib, the *supra-clavicular region* forms a triangle, having its base inferiorly. In the centre is a depression, deeper in the adult than in the infant, in men than in women, and in thin than fat individuals, increasing or diminishing as the shoulders are raised or depressed. This depression, or *supra-clavicular excavation*, is the most important point of the region, whether, from the numerous organs it encloses, the various diseases developed, or, finally, from the operations performed upon it. The pulsation caused by the reflux of the venous blood is remarked here, as in the suprasternal fossa. The lungs occasionally form herniæ, and aneurisms of the subclavian artery most frequently show themselves.

The *skin*, thick, strong, and inelastic above, where it adheres firmly to the subjacent tissues, gradually gets thinner as it descends, becoming more moveable over the muscles; consequently, in the supra-clavicular fossa, it retains all the characters which distinguished it in the sub-hyoid region.

Here, as in the preceding region, the *sub-cutaneous layer* is composed of cellulo-adipose tissue, attached immediately to the skin of the platisma, which does not extend to the edge of the trapezius; and of another layer of cellular tissue, lying above the aponeurosis. Its laminæ, intimately blended at all points, excepting where interrupted by the sterno-mastoid, form a dense and strong layer superiorly, and are converted, inferiorly, into lamellous and filamentous cellular tissue. Nervous filaments ramify in its substance, and adipose vesicles are sometimes met with in abundance.

The external jugular vein, and several branches of the cervical plexus of nerves, lie beneath the platisma, the fibres of which are more separated, and paler at their lower portion. They are directed upwards and inwards, obliquely crossing the external surface of the sterno-mastoid muscle, and external jugular vein.

The *fascia cervicalis* is much less regular here, than in the sub-hyoid region. In thin individuals, and those of a certain age, this aponeurosis consists of several layers, which, in some situations, may be isolated. The different processes, having furnished sheaths to the deep-seated parts of the sub-hyoid region, unite on the internal surface of its deep layer, affording, by their density, considerable protection to the subjacent vessels and nerves.

Cellular tissue and fat enter into its lamellæ, and a spongy tissue resulting, continuous with the cavity of the axilla, inflammation and pus, following the course of the nerves and vessels, extend, with facility, from one to the other of these regions.

The abundance of cellular tissue accompanying the aponeurosis, between the principal muscles, accounting for the tendency of tumours and superficial abscesses to become deep-seated, also led to the practice of making early openings into collections developed beneath the skin.

Muscles.—The *sterno-mastoid*, pertaining to the preceding region, is confounded, superiorly, with the splenius capitis. Its external surface, covered by the jugular vein, the mastoid, auricular, and sub-maxillary branches of the cervical plexus of nerves, is frequently crossed, near its root, by the veins of the shoulder.

The *trapezius*, enclosed between two layers of the aponeurosis, is separated from the skin by cellular tissue only, whilst its anterior surface is prolonged from the omo-hyoid and scalenus posticus muscles, and from the nerves and vessels, by a deep excavation, filled with fat and cellular tissue. Its anterior border limits the incisions practised in exposing the subclavian artery.

The *levator anguli scapulæ* follows the posterior line of this region, and may be discerned between the two preceding, at its point of attachment to the transverse processes of the vertebræ.

Fat and cellular tissue separate it from the trapezius, whilst its anterior surface is divided from the chest and splenii, by the loose elastic cellular tissue forming the communication between the supra-scapular region, and the space comprised between the serratus magnus, the intercostal, and rhomboid muscles, allowing pus and other fluids to circulate through the two regions.

The *omo-hyoid*, frequently converted into a tendon in its passage beneath the sterno-mastoid, crosses, obliquely from below, upwards, the subclavian artery and vein, the three or four principal nerves running to form the bracheal plexus, the two scaleni muscles, the phrenic nerve, and cervicalis ascendens artery. It is sometimes, but not often, attached to the posterior convexity of the clavicle, in which case a fibrous lamella is commonly given off, to fill up the sinus resulting from the union of the clavicle with the acromion and coracoid process.

Ascending in front of the scaleni, the omo-hyoid circumscribes an exceedingly important triangle, which may be named the *omo-clavicular space;* this is divided in two by the scalenus anticus muscle. In its internal portion we meet with the termination of the two jugular and the subclavian veins, the vertebral and inferior thyroid vessels, the acromial vein, phrenic nerve, supra-scapula, posterior and ascending cervical, internal mammary, and subclavian arteries, with the origin of the last cervical nerves. In its external portion are the subclavian vessels, the supra-scapula and transverse cervical veins, the posterior scapula artery, the three last cervical and first dorsal nerves, with a portion of the scalenus posticus muscle, and the first rib.

It next, with the trapezius and sterno-mastoid muscles, bounds another triangle (*omo-trapezoid*), containing the cervical plexus of nerves, or the origin of the branches proceeding from it, the fourth and fifth pair running to the bracheal plexus; various branches of the transverse cervical vessels; and, from above, downwards, the superior extremity of the splenius, levator anguli scapulæ, and posterior scalenus muscles; more deeply seated, the lesser complexus, and a portion of the vertebral artery.

The *scaleni* consist, sometimes, of three or four distinct portions, but more commonly of two only. One, the posterior, is attached to the second rib; the other, anterior, shorter and more rounded, descends internally, and in front, to be attached by a tendon to the tubercle of the first rib.

These two muscles are separated by a triangle, comprising,—

1st, Inferiorly, and slightly anteriorly, the subclavian artery.

2d, Higher, and posteriorly, the first intercostal nerve, united to the seventh cervical and the sixth cervical nerve.

3d, Still higher, a small fleshy fasciculus, sometimes descending, from behind the anterior scalenus, to the costal extremity of the posterior.

4th, Finally, in the apex of the triangle, and above this fasciculus, the two first branches of nerves, running to the axilla.

The internal side of the anterior scalenus, accompanied by the phrenic nerve, transforms the space separating it from the longus-colli muscle into a triangle, in which are situated the vertebral vessels. Some of these muscles are liable to various *anomalies*. The external portion of the sterno-mastoid, for example, may be larger than usual, or attached further externally on the clavicle. The sterno-hyoid and thyroid may arise from this bone, in the supra-clavicular region; and the omohyoid, instead of running to the larynx, may also stop here. In other cases, it arises, at the same time, from this bone, and the scapula. Finally, I have met with an additional fasciculus, convex, superiorly, attached by its two extremities to the clavicle, between the trapezius and sterno-mastoid. In such a case, it would be more than ordinarily difficult to tie the subclavian artery, unless this anormal muscle were sacrificed. The lesser scalenus, on the contrary, occasionally running between the nerves and arteries, renders the operation more easy, by isolating the vessel.

Arteries.—The *subclavian* here forms an arch, with its convexity looking upwards. The better to understand its relations, it must be studied in three different situations: internal to the anterior scalenus; between the two scaleni; and between these muscles and the clavicle. By this arrangement, I retain the name of subclavian, as far as its entrance into the axilla, instead of calling it the axillary at its departure from the scaleni muscles, as is done by several writers, but from what authority I know not.

In the first portion, the two subclavians should be examined individually.

The artery on the right side, larger, shorter, and more superficial than on the left, arises from the *innominata*, opposite the sterno-clavicular articulation, and immediately passes, nearly transversely, over the first rib. Its anterior surface, covered by the phrenic, several filaments of the great sympathetic, and by the nervous vagus crossing it nearly at right angles, is, besides, concealed by the internal jugular, and by the subclavian vein, which, in the living subject, overlaps it a little, in the omo-clavicular triangle. The sterno-hyoid and thyroid, with the sternal portion of the sterno-mastoid muscles, divide all these parts from the superficial layer of the aponeurosis, and are themselves separated from the veins and artery, by a layer of very strong cellular tissue, prolonged into the thorax. Crossed, posteriorly, by the recurrent, and branches of the great sympathetic nerve, it lies on the inferior cervical ganglion, and, still more deeply, on the longus-colli muscle, the transverse process of the first dorsal vertebræ, some cellular tissue, and a few lymphatic glands. Inferiorly, supported by the superior cul-de-sac of the pleura, it corresponds to the apex of the lung. Superiorly, it is situated in the triangle between

the scaleni and longus-colli muscles, where it is in relation with the vertebral and inferior thyroid arteries, the first dorsal, and several filaments of the great sympathetic nerve.

We must, therefore, cut through the internal portion of the sterno-mastoid, and frequently the sterno hyoid and thyroid muscles, to expose the vessel at this point. The parts to be avoided are, superiorly and anteriorly, the vertebral, inferior thyroid, and internal mammary vessels, the pneumo-gastric and phrenic nerves; posteriorly, the recurrent and great sympathetic nerves, and the superior intercostal artery. The only way of preserving these parts, with the exception of the muscles, consists in skilfully opening the fibrous sheath of the artery, as then the nerves are naturally isolated, since they ramify in the surrounding tissues.

On the *left side*, this portion of the subclavian, longer, more deeply seated, and smaller, ascends almost perpendicularly from the arch of the aorta. Its vein, running towards the right side, crosses it in front. The vagus, and phrenic nerves, are rather internal than anterior to it. The thoracic duct, passing to the vein, also crosses it, sometimes behind and beneath, sometimes in front and above. It is accompanied, internally, by the left carotid artery, and cardiac nerves. Externally, it remains much longer in relation with the pleura and lung, than on the right side. The application of a ligature would, therefore, be less dangerous, with regard to the collateral parts. Being placed further from the origin of the vessel, the adhesive coagulum would form without difficulty. The nerves, descending into the chest in a parallel direction, may be easily separated from it; but the extreme depth of the artery, and the neighbourhood of the thoracic duct, completely destroy all these advantages.

The other two portions of the artery being perfectly similar on either side, one description will suffice for both.

Applied immediately upon the groove of the first rib, and termination of the posterior scalenus muscle, the subclavian artery, in the second part of its course, is nearer to the posterior than the anterior scalenus. Superiorly, and rather posteriorly, is the union between the first dorsal and seventh cervical nerves. It is enveloped or covered by thick layers of cellular tissue, and may be compressed at this point, either from above, downwards, upon the bone, or from before, backwards, upon the anterior surface of the scalenus, and transverse process of the first dorsal vertebra. In both these methods the object is attained more surely, and with greater facility, by depressing the shoulder, and, in consequence of the disposition of the muscles, by directing the thumb, or whatever instrument is used, from without, inwards, downwards, and backwards, the rib inclining downwards, and slightly outwards.

It is also behind the clavicle that the artery may be secured

with greatest certainty. It may be exposed, after the various layers of cellular tissue are torn or divided, by following the internal border of the anterior scalenus to its insertion on the first rib, the tubercle of which may be always felt. Running the finger from this tubercle to the front of the posterior scalenus, we necessarily come upon the artery, after which nothing is more easy than to raise the vessel, by introducing a director beneath it, either from behind forwards or from before backwards. This method is so sure, that the artery may thus be secured, even when circumstances prevent its being seen. The vessel is always the first cord met with behind the insertion of the anterior scalenus muscle.

Between the clavicle and this last muscle it inclines strongly downwards, and is reached with greater difficulty as it approaches the axilla. It runs, in the commencement, over the first rib, afterwards over a small portion of the second, and the external surface of the posterior scalenus, finally arriving at the serratus magnus muscle. Its superior or external portion is accompanied by the inferior nerve of the brachial plexus. Anteriorly, it is covered by the subclavian vein, sometimes ascending a little more into the supra-clavicular depression, near the scalenus, but in such a manner, that, in passing beneath the clavicle, it lies internal to the artery, which is next covered in front and above by cellular tissue, some lymphatic glands, a plexus of veins, the cervical fascia, the platisma, and skin.

When we would tie this vessel in the *omo-clavicular* triangle, we should push the omo-hyoid muscle outwards. In some instances we may be forced to cut it across. The operation ought to be performed as close as possible to the anterior scalenus, the artery being more superficial at this point, more easily distinguished from the nerves, and less embarrassed by other organs. The resistance presented by the clavicle, the trapezius scalenus, and sterno-mastoid muscles, being very great, its aneurisms mostly enlarge towards the supra-clavicular depression, in which case the centre of the tumour does not always correspond to the opening of the vessel.

The *other arteries* of this region are all furnished by the preceding.

The *vertebral*, *internal mammary*, and *superior intercostal*, arise internal to the scalenus. The first has been examined in the sub-hyoid region, the two last belong to the thorax. We have, therefore, in this region, the origin of the *inferior thyroid*, the *cervicalis ascendens*, the *transversalis colli*, *cervicalis profunda*, the *supra scapula*, and sometimes the *acromial*.

The *inferior thyroid*, placed a little external to the vertebral, behind the sterno-mastoid, and within the anterior scalenus, ascends, at first, parallel to this muscle, passing behind the carotid, after pursuing this course for about an inch.

The cervicalis ascendens, given off by the preceding, runs upon the scalenus muscle, presenting nothing of any interest, in a surgical point of view.

The *supra-scapula*, sometimes arising from the thyroid, passes between the scalenus and the sterno-mastoid, commonly approaching the clavicle, following its direction: it may, therefore, easily be wounded, in exposing the subclavian. Crossing the brachial plexus of the nerves, in its course to the supra-scapula notch, it is, in its turn, crossed by the external jugular vein, and the supra and sub-clavicular branches of the cervical plexus. When it arises external to the scalenus, it most usually furnishes the acromial, distributed to the summit of the shoulder.

The *transverse cervical*, which also frequently arises from the trunk of the thyroid, curves immediately outwards, towards the supra-scapula depression, running between the same muscles as the supra-scapula, above which it lies. Its course is tortuous, terminating in two branches, one passing anteriorly to the levator anguli scapulæ muscle, the other between this muscle and the trapezius. It is rarely placed so low in the neck as to run any risk of being wounded, in exposing the subclavian artery.

These secondary branches are important in surgery, merely as relates to the ligature of the trunk whence they arise, and then only in two points of view. On the one hand, because, when the ligature is placed close to them, the constant passage of the blood prevents the formation of a coagulum; on the other, because their anastomoses with the arteries of the shoulder are the means by which circulation is carried on in the limb, when the principal vessel is obliterated in the *omo-clavicular* triangle.

The principal anatomical varieties of the subclavian vessels must not be passed over in silence. Whether arising from the innominata, or from the arch of the aorta, as I have observed in two instances, the artery of the right side may proceed in such a manner, from left to right, as to run between the trachea and œsophagus, or between the œsophagus and the spine, before insinuating itself between the two scaleni. The same thing occurred, where the artery of the right side arose from the descending portion of the aorta, as in the case cited by Godman. At other times, the innominata, passing to the left, gives off the artery of that side. I have seen it run in front of the anterior scalenus, whilst the vein was beneath. In another case it was double, embracing this same muscle in its bifurcation. In another individual both vein and artery ran in front; and, in the case mentioned by M. Blandin, both these vessels ran between the scaleni. In a subject dissected by Morgagni, the vein was double up to the point of entrance of the jugular. Robert mentions another case, where it projected

so much above the clavicle, that it was perforated and comprised in the ligature placed upon the artery; and once, in the dissecting-room, I saw a subject in which the two subclavian veins entered the chest, separately, instead of uniting at the neck, to constitute the superior vena cava.

Veins.—The *subclavian* is not similarly disposed, on both sides; on the left, instead of terminating internal to the scalenus, it continues its course towards the posterior portion of the opposite sterno-mastoid muscle, crossing in front of the left carotid artery, the trachea, the thymus gland (when it exists), and even the right carotid. This portion of the left subclavian, called *innominata** by the English anatomists, receives the thymous, inferior thyroid, vertebral, and internal mammary veins, and lies immediately behind the supra-sternal depression. The anterior scalenus muscle separates the artery from the vein on each side. Beyond this point the vein approaches the artery, lying immediately upon it, being ultimately placed to its inner side. Its anterior surface is concealed by the origin of the sterno-thyroid, by the clavicle, and, subsequently, by the subclavian muscle. Inferiorly, it reposes on the first rib, the costo-clavicular ligament, and subclavian muscle. It is covered, superiorly, by cellular tissue, by the different veins emptying into it, the aponeurosis, fibres of the platisma, and, lastly, by the skin. From this description we perceive how easily it may be wounded, in the operation for tying the concomitant artery, the more so as, like all large veins, it swells considerably, during operations of importance. Some surgeons, Lizars among others, have proposed applying a tourniquet on the arm to prevent this, by stopping the venous circulation through the limb. But setting aside the inconvenience of such a method, in cases of aneurism, it would not answer the proposed end, as then the blood would not return less freely by the jugular and other veins of the neck and shoulder. That of the left side, receiving the thoracic duct, opposite the point at which the artery curves between the scaleni muscles, still more augments the danger of a ligature upon this latter vessel. Colles proved this, in tying the right carotid†, in 1813; but did he not go too far in concluding thence, that the operation was impracticable on the left side? And can we agree with Shaw, that in cases of aneurism it were better to amputate the arm, at the shoulder joint, than to tie the artery internal to the scaleni muscles? Does not the anatomical arrangement of the parts demonstrate, that the

* The vena innominata or brachio-cephalic is formed by the union of the internal jugular and subclavian, and is consequently that vessel lying between the superior vena cava and the subclavian, after it has received the internal jugular. It is longest on the left side, and directed transversely, from the left to the right. On the right side it is directed from above, downwards and inwards, appearing more like the continuation of the internal jugular. The latter bounds the right side of the arteria innominata, whilst the former crosses that vessel, at right angles.—H. H.

† Subclavian.—H. H.

removal of the arm would not, in such a case, have any advantage over ligature of the artery? The attempts by Colles and Mott, from analogy, would lead us to admit, that, if the position of the disease so required, it would be better to attempt this ligature than to abandon the patient to certain death.*

* These questions are best answered by a review of the relative position of the parts with their points of origin. The arch of the aorta, in passing from the left ventricle of the heart to the left side, is not directed transversely, but obliquely, from before backwards, and to the left side, at first approaching the sternum, subsequently arching towards the vertebræ. The innominata arises from the summit of the arch of the aorta, or from its most anterior division, whilst the left subclavian commences at the posterior, or descending portion, of that vessel. In its points of origin, therefore, independent of the greater importance of the organs covering and surrounding it, is the impracticability of the left subclavian being tied internal to the scalenus. The depth at which it lies when all the parts retain their normal position, covered, as it is, by a portion of the left lung and pleura, the left carotid artery, thoracic duct, nervus vagus, the large veins, and the several muscles and bones, is also a sufficient reason. But when we consider that the disease requiring this operation would, almost inevitably, not only disturb the order of parts, but considerably increase the depth at which it is placed from the surface ,we cannot arrive at the conclusion that a surgeon would, under any circumstances, be justified in attempting the operation, especially after the opinions expressed by Burns and Colles, and after the failure of the attempts by Sir A. Cooper, in the year 1809. When such men as these, after mature reflection, express such opinions,—when such a man as Sir A. Cooper is unsuccessful, we are sure that it is to no want of anatomical knowledge, to no deficiency either of judgment or skill, but to the natural obstacles (hitherto insurmountable) presented by the part, that these opinions and results must be attributed. In speaking of his operation on the right subclavian in its first course, Dr. Colles observes: "To lay bare the right subclavian artery before "it reaches the scaleni will not be found difficult by any surgeon possessed of a "steady hand and a competent knowledge of anatomy; but I fear that, with the "utmost dexterity, much difficulty will be experienced in passing and tying the "ligature around it, even in the most favourable case. This operation, difficult on "the right, must be deemed impracticable on the left subclavian artery, for the "great depth from the surface at which this vessel is placed, the direct course "which it runs, in ascending to the top of the pleura, the sudden descent which it "makes from this to sink under the clavicle, and the danger of including in the "same ligature the eighth pair of nerves, the internal jugular vein, or the carotid "artery, which all run close to, and nearly parallel with, this artery, these all constitute such a combination of difficulties, as must deter the most enterprising sur-"geon from undertaking the operation on the left side."—Edinburgh Medical and Surgical Journal, No. 41. vol. ii.

Mr. Burns, at page 30 of his valuable work, has the following remarks, which are so important that I am tempted to make a large extract, considering that their value in practice will be a sufficient apology:—

"In tying the subclavian nearer to the heart than the scaleni muscles, there is not "only considerable risk, on account of its connexions, but there is even much danger "to be apprehended from confounding aortic aneurism with aneurism of the sub-"clavian artery. It would be doing injustice to Mr. A. Cooper, were I to omit "mentioning, that to him I was first indebted for the communication of this fact, "which I had lately an opportunity of seeing verified, in a most striking and highly "interesting case,—a case on which several of the most distinguished practitioners "in Edinburgh, and almost every surgeon in Glasgow, were consulted. The nature "of the disease appeared to be so decided, and its situation in the subclavian artery "so clear, that, on that subject, there was no difference of opinion. A tumour, about "the size of a pigeon's egg, was situated just behind the clavicle, and on the acromial "edge of the sterno-mastoid muscle."

After relating the various symptoms, and the progress of the mischief, Mr. Burns, page 39, gives the result of the post-mortem inspection:—

"Appearances were presented which, à priori, no one expected; the vessel, which "was supposed to have been most materially affected, was found perfectly healthy. "The aneurism arose from the aorta, and included a considerable part of the arteria

The external jugular runs in the direction of the trapezius. Commencing by several branches in the parotid region, it empties itself into the subclavian, towards the middle of the supra-clavicular depression. It very frequently receives the veins of the shoulder before it terminates. It is separated from the deep-seated parts by the cervical aponeurosis, and is, therefore, at some little distance from the descending cervical nerves. It, however, occasionally approaches close to the omo-hyoid muscle, which it crosses at right angles. As it opens into the subclavian vein, near the clavicular portion of the sterno-mastoid muscle, in exposing the artery, after cutting through the integuments and platisma, we are obliged to draw the external jugular vein, with a hook or director, either backwards or upwards, and, sometimes, even to apply two ligatures upon it, making the division between them. It is here that it is compressed when opened for the abstraction of blood. Receiving most of the external veins of the cranium, it relieves the sinuses through the medium of the emissary veins. Its communication with the deep jugular explains how the flow of blood is increased by the motion of the lower jaw. The pressure beneath the external opening should not be removed before a compress is applied, as, should the air enter the vessel, it would convert a slight operation into instantaneous death.

The *ascending* and *transverse cervical*, *supra-scapula*, and *acromial veins* nearly always accompany the arteries, but are larger, and constantly more superficial. The two former open into the internal jugular, and the latter into the subclavian. They form a kind of plexus at their termination, external to the sterno-

" innominata. The right subclavian artery was only slightly dilated at its root; " along its course it was rather reduced in size. The tumour mounted from the aorta, " considerably above the sternum, pressing, in its ascent, the descending vena cava " to the right, the trachea to the left; obstructing thus the breathing, and inter- " cepting the return of the venous blood from the head and arms. It also pressed " the root of the right subclavian artery and the carotid against the spine, retarding, " in this way, the circulation along these vessels. The trachea is so much displaced, " that the left carotid slants across its front to reach the side of the neck. The " right side of the heart is little affected, the left ventricle is much thickened, and " the aortic valves are in part ossified, which, together with the obstruction to the " circulation, arising from the pressure of the tumour on the right carotid and sub- " clavian arteries, will explain the increased strength of the muscular fibres of the " ventricle. Just above the heart, the aorta is somewhat dilated; I say dilated, " because its coats are healthy, and its canal free from lymphatic incrustation. " This swell terminates below the commencement of the arch. The inner surface " of the aneurismal sac was coated over with many layers of organised lymph, which " coating was especially thick and strong about the highest part of the sac. The " left part of the arch is of natural size, but a little below the commencement of the " descending aorta the vessel is again dilated into a small pouch. The œsophagus is " pushed completely from behind the trachea."

He goes on, at page 43, to observe,—

" I have related the present case as a warning to all surgeons; and I have to add, " that in subclavian aneurism an operation ought never to be advised, unless where " the fingers can be insinuated between the tumour and the chest; and even then the " arteria innominata ought to be tied, without any very sanguine expectations of " success."—H. H.

mastoid muscle, and above the clavicle. This, as Langenbeck remarks, considerably increases the difficulty of tying the subclavian artery. In addition to these, there are some few veins proceeding from the thorax, but too inconsiderable to deserve further notice.

The internal jugular vein belongs to the subclavian region, only at its termination. Situated behind the sterno-mastoid muscle in front, and external to the anterior scalenus, it separates a little from the carotid, leaving between it and the artery a small elongated triangle, containing the pneumo-gastric, phrenic, and great sympathetic nerves. On the left side it runs into the subclavian, a little internal to the point where the thoracic canal terminates. On the right side it is almost directly continuous with the superior vena cava.

The *lymphatics* collect from the neck, shoulder, and a portion of the exterior of the chest. We here find numerous glands, some beneath the sterno-mastoid, behind the clavicle, others in the supra-clavicular cavity; swelling of the former may resemble aneurism of the neighbouring arteries, causing pressure upon the carotid artery, internal jugular vein, and subclavian vessels. The latter but rarely lead to mistakes of this nature, but would more particularly compress the nerves. They are extirpated with difficulty, and considerable danger, in consequence of their proximity to the large vessels.

In the case of a young female, operated upon by one of the most skilful surgeons in Paris, although the hemorrhage was not instantaneously fatal, the patient died on the eighth day, from phlebitis.

Nerves.—Almost completely covered by the sterno-mastoid muscle, the *cervical plexus* lies in front of, and external to, the scaleni. The *sub-maxillary* branch of this plexus winds, over the external surface of the sterno-mastoid, to the sub-hyoid region. The *anterior auricular* ascends, in a similar manner, to the parotid region, and the *mastoid branch* runs, perpendicularly, upwards to the summit of this region. Among the descending branches, the *spinal accessory** is the most remarkable. Having pierced the sterno-mastoid, it descends between the levator anguli scapulæ and the trapezius. We should endeavour to avoid this nerve, in bleeding from the jugular, and in removing tumours from this region. However, when it enters the trapezius, it is situated deeply behind the aponeurosis. The *supra* and *sub-scapular*, *supra-acromial*, *cervicalis-descendens*, and *pro-*

* The spinal accessory is not generally considered as a branch of the cervical plexus, although it receives filaments from the cervical nerves previous to their exit from the spinal canal. It arises from that portion of the spinal cord, termed by Sir C. Bell "the respiratory tract," between the two roots of the cervical nerves, generally opposite the fifth. From its origin it ascends through the foramen magnum occipitale into the cranium, which it leaves, together with the glosso-pharyngeal and pneumo-gastric, by the posterior lacerated foramen, being described and considered, by most authors, as a division of the eighth pair.—H. H.

funda, diverge beneath the aponeurosis, between the trapezius and sterno-mastoid, and are situated, for the most part, in front of the omo-hyoid muscle, but behind the external jugular vein.

In operating on the subclavian artery, several of these are divided, in consequence of the dense filamentous cellular tissue surrounding them; and as they ramify, chiefly, on the upper part of this region, and, if wounded, are likely to cause considerable inconvenience, the external jugular should rather be opened below than above.

The *phrenic* merits much attention. Rising from the third and fourth cervical nerves, it very frequently appears to emanate from the plexus of this name. Crossing the branches proceeding to the brachial plexus, it descends in front of the anterior scalenus, on the outer side of the internal jugular vein, completely covered by the sterno-mastoid muscle. Entering the thorax, it runs between the subclavian artery and vein, opposite the point of union between the two internal and external portions of the former vessel. It is, therefore, liable to be injured in operating internal to the scalenus muscle.

The external or posterior *thoracic* arises from the fourth and fifth cervical branches, in front of the posterior scalenus, and supplies the serratus magnus muscle. It requires no further observation.

The *brachial plexus of nerves* situated in the space between the two scaleni, are so arranged, that the sixth cervical, as also the trunk resulting from the union of the seventh with the first dorsal nerve, are frequently separated from the others by the small fleshy fasciculus, passing from behind the anterior scalenus to the front of the costal extremity of the posterior muscle of that name. In this case, the subclavian artery, and the two first nerves, are contained in a triangular space, having its base in the first rib. The others, less isolated, are also inclosed in a triangular space, with its base corresponding to the posterior scalenus muscle. In more than one instance, one of the two first has been mistaken for the artery. This, however, may be avoided, by observing, that the artery is always the first object met with after the tubercle of the rib; that the nerve, whilst more elevated, is at the same time more posterior, lying on the muscle, the artery being, in reality, placed upon the bone; and that the latter, of a pale-yellow colour, flattens itself upon the instrument; whilst the nerve is of a reddish-white, harder, rounder, &c. As they pass beneath the clavicle, all these nerves form a fasciculus, a kind of bundle, the arrangement of which is not always the same. Superiorly and externally, they are accompanied by the levator anguli scapulæ muscle, and the omo-hyoid, the latter more superficial. Approaching the axilla, the most inferior cord, which was placed upwards and backwards, on the first rib, becomes anterior, and a little ex-

ternal. The sixth cervical approaches very close to the artery, even touching it in its passage beneath the clavicle.

We must not forget that this plexus, before it enters the cavity of the axilla, besides the posterior thoracic nerve, gives off several other branches, the *anterior thoracic* supplying the anterior of the chest. One of these, more constant than the others, is worthy of attention; it frequently arises by two roots: one passing behind, the other before, the subclavian artery, and uniting, enclose the vessel in a kind of ring, which should be avoided as much as possible in the application of the ligature.

The *pneumo-gastric* belongs to the supra-clavicular region, only at the point where it enters into the cavity of the thorax. On the right side, before passing in front of the artery, it is placed opposite the vertebral vessels, which remove it from the front of the transverse processes, and the external portion of the longus-colli muscle. Separated from the trachea by the carotid, and from the anterior scalenus by the jugular, it is covered by the subclavian vein. At this point, it gives off the inferior *laryngeal nerve*, in front of the artery, around which it winds, ascending, posteriorly, towards the œsophagus and trachea, forming a kind of nervous circle, of importance in the operation upon the subclavian, internal to the scalenus.

Great sympathetic.—We have now only to speak of the filaments proceeding from the inferior and middle ganglions, producing a plexus round the subclavian vessels. These unite with the cardiac branches, and some others derived from the recurrent, forming so complicated a network that they can scarcely be avoided, in exposing the first portion of the artery. To this circumstance may be attributed some of the inconveniences succeeding this operation and, among others, the disturbance of the heart's action.

The *skeleton* is composed of the clavicle and first rib.

From the arrangement of these two bones, results a triangular space, having its base externally. The direction of this space, perpendicular, when the shoulder, forcibly carried backwards, is raised as high as possible, remains, on the contrary, horizontal, when the clavicle is lowered, and drawn forwards. The costo-clavicular ligament, so disposed as to limit the motions of the clavicle, upwards and forwards, is separated from the subclavian vein by a thin layer of fat. The subclavian muscle extends along the inferior surface of the clavicle, as far as the point where this bone receives the insertion of the coraco-clavicular ligaments. The subclavian vessels and nerves are disposed in the following manner: first, the vein; next, the artery, more posterior; afterwards, the inferior cord of the brachial plexus, slightly covering the front of these vessels; finally, the remaining branches of the same plexus, placed more externally, and posteriorly. Langenbeck is, consequently, mistaken, when he advances that the artery is more superficial than the nerve.

More externally, this space is filled by cellular tissue, fat, lymphatic glands, small nerves, and vessels. Through here, morbid fluids, formed beneath the aponeurosis, spread, and descend into the axilla, and behind the thorax.

The artery and vein, fixed by a fibrous sheath, may be so much compressed that their calibre is completely effaced, in certain positions of the shoulder; as, for example, when this part of the body is carried forcibly backwards and downwards. The same may occur when an individual lies in such a position that the weight of the body falls principally upon the shoulder; the pulse then cannot be felt at the wrist; a circumstance which would embarrass the practitioner, if he were not alive to the cause. In hemorrhage of the axillary artery, this peculiarity may be made available.

The nerves occupying a larger space of the triangle, compression is necessarily less prompt and complete. However, when the approximation of the bones has been carried to any extent, the numbness resulting is a proof of its having been effected.

These various organs are, therefore, freer the more the shoulder is raised; but, in this position, the artery lies at such a depth, that it is difficult to secure it. Unfortunately, this is most frequently the case, when it requires tying. In fact, aneurismal tumours of the axilla, which do not allow of a ligature anterior to the clavicle, never acquire any great size, without pushing the shoulder upwards.

In the forced contraction of the double costo-clavicular triangle, the clavicle acts like a lever on the first rib. The anterior sterno-clavicular ligament alone prevents its dislocation forwards. In separation, on the contrary, the costo-clavicular ligament opposes its luxation backwards, as firmly as the proper ligament of the articulation. Superficial, and projecting forwards, the clavicle is the bone most exposed to the action of external agents; thus, it is very liable to direct fractures and exostosis. Separated from the vessels by the subclavian muscle, and merely covered by the skin, we can, if necessary, saw through it, and expose the artery between the pectoralis major and deltoid muscles. But the vascular or nervous ramifications, and the fibro-cellular layer, which should be preserved in prolonging the incision upwards and downwards, would, perhaps, render this operation more difficult, and quite as dangerous as by the ordinary process. Its relation with the axillary vessels is such, that, being fractured, its broken portions may wound either the nerve, vein, or artery, although this occurrence is very rare, and that, too great formation of callus may lead to much mischief.

The first rib is important, in more than one respect. Its cartilage, large, thick, very strong, and short, unites it with the sternum; being thus an element of force and resistance. Its

vertebral extremity presents a rounded head, but only one articulating surface. Its tuberosity is not attached to the transverse process. The ligaments uniting it to the spine, weaker and less fibrous than those on the following ribs, are, thus, elements of motion. It was this contrary arrangement of the two extremities of the first rib, which gave rise to the opposite opinions of Haller and Magendie. But it appears to me that the strength of the cartilage, and shortness of the bone, though proving Haller right, do not prevent the mobility of this rib upon the spine, nor the elevation of the whole of the thorax. Passing from the sternum to the vertebræ, we see that its superior surface is, at first, large, horizontal, and slightly raised. The costo-clavicular ligament is attached to it, obliquely, from within outwards, and from behind forwards; hence, a depression, circumscribed by the clavicle, and grooved on the posterior surface of the ligament supporting the subclavian artery and vein; afterwards, inclining slightly outwards and backwards, it presents, in this situation, a superficial depression, upon which lies the vein. The tubercle is the next point, and to this is attached the anterior scalenus muscle, and, subsequent to the tubercle, the groove lodging the artery. The tubercle is rather larger internally than externally, on account of the arterial fossa being nearly transverse, whilst the venous depression is directed obliquely backwards. The rib here becomes smaller. Finally, the rest of the surface again enlarges, is raised, assumes the horizontal position, and receives the attachment of a portion of the posterior scalenus.

The following is the order of parts, from the skin to the first rib:—

1. Skin.
2. A thin layer of cellular tissue.
3. The platisma muscle, in the anterior half of the region only.
4. Another layer of cellular tissue, thin, lamellous, supporting the platisma, and in which the external jugular vein ramifies.
5. The aponeurosis, splitting anteriorly, and posteriorly, to envelope the sterno-mastoid and trapezius muscles.
6. A considerable quantity of cellular tissue, fat, lymphatic gland, the nerves of the cervical plexus, veins, and secondary arteries, and, quite inferiorly, the subclavian vein, and omo-hyoid muscle.
7. The phrenic nerve, and anterior scalenus muscle.
8. The nerves of the tracheal plexus, and subclavian artery.
9. The posterior scalenus and the bone.

SECTION THIRD.

NAPE, OR POSTERIOR PART OF THE NECK.

The *posterior region* of the neck, commonly termed the *nape*, limited, superiorly, by the occipital protuberance, the superior semicircular line, and the mastoid process of the temporal bone; inferiorly, by the shoulders and the spinous process of the seventh cervical vertebra; laterally, by the supra-clavicular region, is rounded in the centre. Superiorly, it is larger, and contracted backwards; inferiorly, it is smooth and still larger. Its length varies in different individuals, as does its size. These peculiarities commonly depend on the degree of prominence—on the elevation or depression of the shoulders, and, also, on the developement of the muscles and other soft parts. We remark, externally, a triangular excavation, limiting the prominence of the complexi muscles, and in which issues are generally made. Bounded by the spinous process of the dentator, this fossa corresponds to the interval separating the occiput from the atlas, a situation in which the medulla oblongata may easily be wounded. A simple fissure, observable when the head is extended, prolongs it inferiorly, and renders the cervical spines scarcely evident to the touch. At the most inferior part, we see the spine of the seventh cervical vertebra, projecting in so marked a manner, as to have received the name of *prominent;* and which, occasionally, even in the adult, remains moveable, like a sesamoid bone; thus resembling fracture.

The substance of the skin is considerable; greater in the median line, and over the muscular eminences, than anteriorly and laterally. The great resistance which it offers, explains the intense pain attending furuncula, in this situation. Very elastic, but little vascular, and almost entirely composed of fibrous tissue, it, according to some persons, owes its freedom from acute or chronic pustular affections to the predominance of its solids over the fluids. This opinion I consider without foundation, as porrigo, herpes, &c. occur here as frequently as elsewhere. It is sometimes wrinkled transversely, especially in old age. The hair, which covers it superiorly, commonly descends as far as the axis; the rest of its surface is bare. It has but few sebaceous follicles. Most adherent inferiorly, it is, nevertheless, sufficiently moveable to form a fold of considerable thickness, when we would introduce a seton. The middle of the region is the most advantageous on this account, and is also preferable for other reasons. For example, the dressing is simpler; and the same may be said of blisters. In fact, where the wound is situated beneath this point, it is difficult not only to apply a bandage, but to retain it in its situation, and prevent its sliding from

below upwards. When the seton or blister is placed above, the same inconveniences occur, but inversely. Issues are not influenced by this law, as they should be placed, in preference, in the sub-occipital fossa; particularly as, from the structure of the parts, it acts more directly on diseases of the brain, or its membranes.

Generally thin, formed of dense lamellæ and filaments, and firmly adhering to the skin, the *subcutaneous layer* encloses, on its deep-seated surface, fat, occasionally, in large quantities. Its other surface adheres, strongly, to the *ligamentum nuchæ*, with which it is sometimes confounded. Pus, in erysipelatous inflammations, forms in its substance. From the great resistance of the skin, and its slight extensibility, abscesses are rarely circumscribed, but spread rapidly, in different directions, over the posterior region of the neck. We should, therefore, make incisions early, even when fluctuation is obscure.

Aponeurosis.—We have seen in the supra-clavicular region, that the cervical aponeurosis forms two layers at the edge of the trapezius muscle. These unite on the median line, and concur in forming the ligamentum nuchæ, the common point of union for all the inter-muscular cellular layers. In man, reduced to a simple fibro-cellular band, this ligament extends from the occiput to the last cervical vertebra, unites the spinous processes to the skin, and separates the muscles of the one side from those of the other. In quadrupeds, especially the carniverous, it is extremely strong; its nature, evidently the same as that of the yellow ligaments, endowing it with extreme elasticity; the heads of animals are naturally drawn backwards, when the flexor muscles relax. A few nervous filaments, from the posterior cervical branches, ramify on the superficial portion of the aponeurosis, which, thin, and strongly united to the trapezius muscle, is less intimately attached to the subcutaneous layer. Thus, nothing is easier than to dissect off the skin from the back of the neck, comprehending the cellular tissue investing it, without injuring the aponeurosis.

The numerous *muscles* in this region are arranged in various superimposed planes. United in the median line by their aponeurosis, which enlarges as it descends, to form the lozenge-shaped space, of which the spine of the seventh vertebra is the centre, the *trapezii* constitute the first layer, separated from the skin by its subcutaneous tissue. The *splenii* form a second layer, separated from the former by a strong aponeurotic lamina, and inferiorly by a portion of the rhomboid muscle. Extending to the head, they leave a triangular space between them, the apex of which corresponds to the centre of the neck, and in which the trapezii lie immediately upon the complexus. The occipital artery enters the upper part of this space, in its course to the back of the cranium.

Covered by the rhomboid, the serratus posticus superior, the

splenii and trapezii muscles, the *complexi* are divided by the ligamentum nuchæ. They are composed of numerous fasciculi, and cross the root of the splenii muscle very obliquely.

Between the trapezius and the second layer of muscles, the cellular tissue, filamentous and very dense superiorly, lamellous in the middle, much looser inferiorly, encloses, externally, a certain quantity of adipose cells. Between the splenii and complexi, this tissue is less abundant, excepting at its upper portion. Between the complexi and the subjacent muscles, it forms laminæ, very indistinct in the two inferior thirds of the region, but well marked superiorly, where it exists in large quantities.

The muscles, which do not cover the whole of the posterior region of the neck, may be divided into two series, or those situated above and those below the axis. The latter form a mass, which, filling the cervical grooves, is composed, from the ribs towards the median line, of the sacro-lumbalis, transversalis colli, longissimus dorsi, semi-spinales colli; in a word, of the prolongation of the different fasciculi entering into the composition of the sacro-spinal muscle.

Each *rectus capitis posticus major muscle*, extending from the spinous process of the second vertebra to the inferior curved line of the occipital bone, external to its crest, forms the side of a triangle, which we will examine hereafter.

The *small recti* ascend from the tubercle of the atlas to the fossa, behind the foramen magnum of the occipital bone, on each side of the crest. Covered by the preceding, they lie immediately upon the *occipito-atlantal ligament*.

The *obliqui postici* are so disposed, that the inferior proceeds, from the spine of the dentator, to the transverse process of the atlas, and the superior, from this latter process to the occiput, between the semicircular lines, close to the rectus magnus. In the *triangle* circumscribed by these and the large recti are several important organs; such as the vertebral artery, suboccipital nerve, also a portion of the ligaments uniting the two first vertebræ with each other, and to the occipital bone. This space, covered by the complexus, is filled by fibro-cellular tissue, which, adhering very firmly to the muscles, nerves, and vessels, becomes blended with the ligaments and periosteum.

The *small muscles* (*inter-spinales*) situated between the spinous processes, from the second to the seventh vertebræ, replaced between the atlas and axis, and between the occiput and atlas, by the posterior recti, are double, symmetrical, and appear to support the opinion, which I have elsewhere expressed, that the fibrous yellow tissue is capable of becoming converted into muscular fibre, according to the necessities of the organs between which it is situated. The inter-transversales, equally double, each circumscribes a triangular space, through which the cervical nerves pass; but in such a manner that these nerves cannot be compressed by their contractions.

The *arteries* are all derived from the anterior of the neck. The horizontal branch of the *transversalis colli* ramifies principally between the two first layers of muscles.

The *cervicalis profunda*, emerging from the space between the two last cervical vertebræ, supplies the spinal muscles; afterwards running between these and the complexi, in which they terminate.

The *cervicalis ascendens* supplies the same parts at the upper portion of the region.

The *occipital* is the most important of all. Arising from the external carotid, it arrives at this region, by passing between the atlas and axis, internal to the sterno-mastoid and splenius-capitis muscles. It next ascends, tortuously, over the external surface of the complexus, covered by the splenius and trapezius, which it traverses to distribute itself in the subcutaneous layer of the cranium. It may be exposed by cutting through the skin, subcutaneous cellular tissue, and aponeurosis, and by separating the trapezius from the splenius for about two inches downwards, from the superior curved line of the occipital bone.

In consequence of this arrangement, wounds, at the upper part of the neck, may be succeeded by profuse hemorrhage; whilst, inferiorly, there is no artery of sufficient size to render this of importance.

The *vertebral*, enclosed in the canal of the transverse processes, is sheltered from external violence as far as the axis, and can only be wounded by sharp or pointed instruments being introduced between two of the vertebræ. Emerging from the third, it forms an arch, convex posteriorly and externally, exposed to the action of all bodies capable of penetrating as far as the spine. Curved, anteriorly and externally, as it traverses the atlas, it is again protected from external injury. Quitting this vertebra, to enter the cranium, through the foramen magnum, it winds behind the condyle, on the posterior surface of the occipito-atlantal ligament, which it pierces, or, rather, from which it derives a kind of fibrous ring, completed by the basilar process of the occipital bone. It here forms a very decided curve, lying, much exposed to injury, in the triangle formed by the divergence of the oblique muscles. The branches, which it gives off, before it enters the cranium, are so small that they are undeserving of any further notice.

The *veins* ordinarily accompany the arteries, and empty themselves into the internal jugular. Some placed in the cellular layer carry the blood to the external jugular. The former receive some of the emissary veins of Santorini; but are too irregular and deeply seated to allow of any general rule as to the abstraction of blood.

The *lymphatics* of the subcutaneous layer are few, and run to the superficial cervical glands. Those deeper seated descend partly into the axilla, and partly beneath the sterno-mastoid

muscle; hence sympathetic swelling of the axilla and sub-hyoid region in numerous diseases of the posterior portion of the head and neck. I have frequently found two or three glands on the splenius, about an inch from its upper extremity, between the sterno-mastoid and trapezius, covered by the skin and subcutaneous tissue.

A correct knowledge of this fact may be of utility in preventing any mistake, with regard to the nature of the tumours which they may produce.

Nerves. The posterior branches of the cervical nerves furnish a certain number, the *cervical plexus* supply others, and the *sub-occipital* is principally distributed here. The former are, at first, placed between the splenii and complexi muscles; but their branches almost immediately divide, some running to the complexus and deep mass of muscles, the others traversing the muscular layers, covering them, and all sending branches to the subcutaneous cellular tissue. The *spinal accessory* ramifies in the trapezius, which, with the levator anguli scapulæ, is also supplied by the cervical plexus. The latter are chiefly confined to the inferior region of the neck. The preceding occupy the upper portion, being, for the most part, lost in the various muscles. Other filaments, derived from the auricular and mastoid branches, confined between the laminæ of the aponeurosis, are ultimately lost in the subcutaneous cellular tissue. The *sub-occipital,* which may also be considered as the first cervical, is the most important of all the nerves in this region. Passing between the cranium and the atlas, it immediately enters the triangular space circumscribed by the obliqui and rectus magnus muscles of the head, enveloped in, and adhering firmly to, the cellular tissue filling this space. It here gives off its three principal branches, one of which descends, like the deep branches of the other cervical nerves, beneath the complexus, which it ultimately pierces. The two ascending, proceeding towards the occiput, thus traverse the muscles, or their interstices, anastomosing, between the aponeurosis and skin, with the superior branches of the cervical plexus, and others derived from the facial.

The abundance of nerves, and the condensed texture of the various tissues in the supra-axioidal portion of this region, in some measure, explain the intense pain caused by inflammation and the formation of tumours, and the infrequency of defined abscesses.

The *skeleton* comprehends a large portion of the occipital and all the cervical region of the spine. The portion of the occipital bone appertaining to the neck, having already been described elsewhere, will not require further notice at present. Laterally, are two prominences, corresponding to the posterior portion of the cerebellum. The bone, extremely thin, is here covered by a thick layer of soft parts. Fractures occur very frequently, and are the more formidable, as they are with difficulty discovered.

These prominences may be perforated by tumours of the dura mater, and even by the pressure of the cerebellum itself. In the latter case, the result is hernia of the cerebellum; two cases of which have been recorded by Lallement and Baffos.

It has been generally understood, that we should not trephine beneath the superior occipital curved line. However, if positively indicated, the operation would neither be very difficult, nor much more dangerous than in other points of the cranium, if it be performed on the side, and not in the median, or superior semicircular ridge. It has also been said that tumours of the dura mater should not be removed, even should they pierce the cranium. Reason and facts appear to support this opinion; nevertheless, it is possible, that a tumour may have perforated the bones, although the brain and dura mater be not much disorganized. Under these circumstances, I do not see why its extirpation should not be attempted; especially if the progress of the disease is likely to destroy the patient. A female died, in 1825, having a hard and immoveable tumour, situated at the inferior and internal portion of one of the occipital prominences. This tumour, which had perforated the bone, was about the size of a common nut, and the fibrous membrane was perfectly healthy, at about a line external to it. It was, therefore, evident, that it might have been removed, and that the operation offered the same chance of success as in any other part of the body.

The *vertebral column* is concave in this region. Its *spinous processes* are of unequal length. The first vertebra, having none, allows of the head being directed backwards. That of the second is large and very long; that of the third very short. Those succeeding increase gradually, as far as the seventh; so that from the axis to the seventh there is a depression filled with soft parts, which would lead us to select the centre of the neck as the proper situation for the introduction of a seton. Being nearly horizontal, and, consequently, some distance from one another, they allow a certain degree of motion to the parts.

The *transverse processes*, also very short, diminish gradually from the seventh, and from the first to the third. The extent of motion, which they enjoy, is a natural consequence of their shortness. Their base is traversed by a canal, for the passage of the vertebral artery, thus protected from the action of external bodies. The nerves pass behind the artery, and divide external to it.

The *articular fossæ*, more horizontal than in the other regions, incline more and more from the second to the seventh, rendering displacement more difficult the farther they are from the axis. Luxation of the cervical vertebræ beneath the axis, admitted by some and rejected by others, is certainly possible, there being several incontestable proofs upon record. When there is only one fossette pushed anterior to another, without the intervertebral cartilage being torn, the luxation is incomplete,

and may exist without paralysis; but if the four surfaces are separated at the same time that the fibro-cartilage is torn, paralysis occurs instantly, and sometimes death.

It is between the atlas and second vertebra, that the arrangement of these surfaces is most interesting. Here they are smooth, horizontal, or slightly inclined outwards. On the other hand, the atlas has no lamella, properly so called; no spinous process; no body, consequently, no yellow ligaments or fibrous cartilage. The result is, that movements may occur, naturally, in all directions,—that rotation may be carried very far, without danger, but if it extends beyond the fourth of a circle, luxation ensues, because then one of the fossæ of the atlas passes in front, and the other behind that of the axis.*

The union of the head with the spine merits particular attention. The condyles of the occiput, convex, elongated, directed obliquely, outwards and backwards, in relation with the superior articulating surface of the atlas, merely allow of flexion and extension. But as the occipito-atlantal ligaments are elastic and large, as the posterior arch of the vertebra is thin, and possesses no spinous process, this double motion may be carried to a great extent.

The *odontoid process*, a kind of pivot on which the atlas turns, fixed internal to the condyles of the occiput, by two short fibrous fasciculi, can only press upon the spinal cord, after having ruptured the transverse ligament of the first vertebra; unless it pass beneath it, in which case the odontoid ligaments would be previously torn. We may conceive that considerable violence would be necessary to produce either of these results; it, however, appears that hanging frequently causes the latter. Most commonly the ligaments of the odontoid are ruptured first, and the process next slips from its ring into the spinal canal, tearing the marrow, and producing instantaneous death. Occasionally, also, the transverse ligament is broken, and death occurs in the same manner.

Among *children* it requires less effort to produce the same effect. The vertical odontoid process of the second vertebra is but slightly developed in early years, its ligaments present much resistance, and the ring containing it is less firm. We can thus comprehend how, in raising a child from the ground by the head, instantaneous death may be produced, if it makes any resistance. Such was the case reported by J. L. Petit.

The two first cervical vertebræ are united with each other and with the head, in such a manner that an instrument may penetrate the spinal canal, dividing only the soft parts, and producing instant death, from injury to the upper portion of the marrow. Thus, by plunging a pointed or cutting instrument through the sub-occipital fossa, we might arrive at the occipito-

* This accident is, in a great degree, prevented by the odontoid ligaments; in fact, unless one of these were ruptured, I do not see how it could occur.—H. H.

atlantal, or occipito-axioidal ligaments, and divide the commencement of the cord. If the instrument were introduced anteriorly, it would not be attended with the same risk, as the odontoid process would then prevent its running directly to the spinal marrow.

Beneath the second vertebra, injuries of this nature cannot occur, as the bones are here so firmly knit that they form a complete canal, presenting no space through which a foreign substance can enter, unless it were obliquely, from below upwards.

A wound of the cord, between the first vertebra and the occipital bone, would leave the roots of the pneumo-gastric, glosso-pharyngeal, and lingual nerves untouched. Between the first and second vertebræ, all the others would be separated from the brain, with the exception of the sub-occipital. Between the second and third, a portion of the cervical plexus would remain; between the third and fourth, all this plexus would be out of danger, as also the spinal accessory, of which only one or two roots would be destroyed; between the fourth and fifth, the phrenic would not be implicated. The brachial plexus would, in part, escape. Finally, below this point, there would not, necessarily, be paralysis of the upper extremities.

The muscles at the back of the neck are enveloped in fibro-cellular sheaths, as in the sub-hyoid region; but as these are united by dense filamentous tissue, pus rarely infiltrates, but phlegmonous deposits are sufficiently common. Confined within the dense texture of the muscles, aponeurosis, and cellular tissue, the nerves account for the suffering attendant on acute diseases, the danger of wounds, and also for tetanus, sometimes resulting from punctures.

The disposition of the muscles is such, that fluid thrown out in the deeper parts with difficulty reaches the surface. However, when once beneath the integuments it spreads rapidly, in consequence of the slight adherence between the skin and aponeurosis, and the great thickness of the former. All these are reasons favouring re-absorption in ecchymosis, but indicating the necessity of making early incisions into abscesses of this region, whether superficial or deep.

The extended motion of the large synovial membranes, the continual friction of the articular surfaces, the multiplicity of the ligaments at the upper part of the spine, sufficiently account for arthritis, caries, inflammations, and ulcerations, &c. observed in this region. The relations of the atlas and odontoid process to the medulla oblongata, and the pneumo-gastric nerve, explain why patients die, or become paralysed so quickly, in those cases, where the disease reaches the interior of the spinal canal. The size of the rings of the two first vertebræ show, in their turn, why exostosis of their interior,—the displacement of the odontoid or articulating processes, is so immediately fatal.

CHAPTER FIFTH.

OF THE CHEST.

Placed near the centre of the trunk, of which it forms the middle cavity, the chest, continuous, superiorly, with the neck, inferiorly with the abdomen, serves as a point of attachment to the superior extremities.

Reduced to its skeleton, it represents a truncated cone, having its base inferiorly. Surrounded, on the contrary, by its soft parts, it is, as it were, flattened, and larger superiorly than inferiorly. Its transverse dimensions, taken from one shoulder to the other, are much more considerable than the antero-posterior. This, however, varies according to the age and sex of individuals.

Anatomists have been accustomed, for a long period, to divide the walls of the thorax into four regions, and as this division may be traced with tolerable correctness, externally, I have thought it best to abide by this arrangement, merely indicating the slight modifications, which appear to me indispensable in speaking of the principal sections.

We will treat of the interior, or the cavities of the chest, in another chapter.

SECTION FIRST.

OF THE THORAX.

Sternal region.—Limited, superiorly, by the sub-hyoid region, inferiorly, by the epigastrium, and, laterally, by the breasts, the sternal region presents—

1. In the median line, from above downwards, the suprasternal fissure, corresponding to the arteria innominata and left subclavian vein.*

2. The depression of the first bone of the sternum.

3. An eminence, which does not always exist, depending upon the angle of union between the two first bones of the sternum and the attachment on each side of the second rib.

4. A second depression, more regular than the preceding, augmenting, generally, in depth and extent, as it approaches the xyphoid appendix.

5. Laterally, the prominence depending on the head of the clavicle.

6. Inferiorly, in thin individuals, a series of depressions and eminences, in relation with the intercostal spaces, and the cartilages circumscribing them.

* Vena innominata.

7. In stout persons, on the contrary, an elongated projection, parallel to the axis of the body, dependent on the muscles and fat.

Infancy, sex, fat, and the constitution cause numerous modifications in these particulars. In early age, the sternal region, generally very prominent, has no elevations on its sides. In the female, it is flatter and shorter, but the breasts make the centre depression appear deeper, and the extremities of the clavicles more projecting. In some individuals, it juts out, as in infancy, and this disposition, frequently coinciding with rachitis, leads to dread of phthisis pulmonalis. In others, on the contrary, it is more depressed than natural. This is especially observed among artisans who work with the trunk habitually bent forward, or who make their chest a point of resistance, as in shoemakers. Finally, we not unfrequently meet with a certain degree of mobility in the median line, arising from incomplete and irregular union of the different portions of the sternum. It is necessary that we should bear these variations in mind, when we treat fractures or tumours on the anterior of the chest.

Thicker in the middle than laterally, the *skin* of the sternal region, in man, is covered with hair, having their roots surrounded by large and numerous follicles. Thus lupia, &c. frequently occur here, whilst they are rare on the sides. Its elasticity being greater externally than on the median line, tumours generally increase in size in the former direction. Composed of lamellæ and filaments, the *subcutaneous layer* forms, in thin subjects, a very elastic membrane, externally, where it replaces the fascia. Arriving at the centre, it becomes more dense, as it were, fibrous, and unites to the sterno-costal ligaments. We can separate one layer from it, which more particularly adheres to the skin, and which contains adipose vesicles.

Such is the disposition of the subcutaneous lamellæ, that they may be divided into three externally, blending in the median line, where they rarely enclose fat. As they unite the integuments very firmly to the bones, wounds over the sternum are closed by first intention with so much difficulty, that, in operations performed in this region, it is necessary to preserve as much skin as possible. In cases of infiltration, or excessive fat, the sternum appears much depressed, tumours and abscesses rarely acquire any great size, and ecchymosis is circumscribed. From the clavicle to the sixth rib, the aponeurosis merely consists of simple cellular tissue, which becomes blended with the periosteum, and the above-mentioned lamellæ, anterior to the sternum. More inferiorly, we remark a complete fibrous sheath, increasing in thickness as it approaches the epigastrium. Its form is flattened, its fibres passing obliquely inwards, and becoming continuous with the aponeurosis of the abdomen. It more particularly covers the recti muscles, binding them down to the ribs. As this membrane is but thin, and of little density,

superficial inflammation, effusions of blood, and abscesses easily pierce through it, to become deep seated, and reciprocally. Infiltration from one layer into the other meets with but little obstacle, whilst subcutaneous inflammations, occurring in the sides of the region, are, nearly always, at the same time circumscribed and diffused.

Muscles.—The *pectoralis major*, attached to a curved line, the convexity directed to the opposite side, leaves a free space on the sternum, larger, superiorly and inferiorly, than in the centre. The space is most marked in those persons in whom the muscles are largely developed. Separated from the skin by the thickest portion of the subcutaneous layer, this muscle allows the superficial cellular tissue to communicate with the deep cellulo-adipose layer, by the fissure dividing its sternal and clavicular fibres. Hence, transition of inflammation and pus, from the sternal region to the axilla, and vice versâ. The relief, which it forms by its insertion at the cartilages of the ribs, indicates the course of the internal mammary artery. Its inferior border, in general sufficiently prominent, where it terminates on the sixth rib, is a guide when we would count the bones.

The *rectus muscle of the abdomen* commonly interlaces, externally, with the last denticulation of the preceding, and is attached, sometimes, to the sides of the base of the sternal appendix, and always to the seventh and eighth ribs. Its fibres, parallel to the axis of the body, are commonly intersected on the epigastric border of the chest by a fibrous band, much more complete anteriorly than posteriorly, and adhering firmly to the aponeurosis. We not unfrequently find the superior extremity of this muscle ascend higher up, either by a portion or the whole, reaching even the insertion of the sterno-mastoid; thus representing its natural disposition in most of the mammiferous animals. Other supernumerary fasciculi have also been seen at different points. Sometimes, there is a small distinct muscle descending from the superior extremity of the sternum towards one of the cartilages of the ribs, restraining the pectoralis major; sometimes, on the contrary, there is a fasciculus detached from the pectoralis major, sterno-mastoid, and rectus muscles. These muscles may raise the skin sufficiently to form projections, which must not be mistaken for pathological swelling.

A small portion of the *external oblique* muscle of the abdomen lies at the inferior and external part of this region, between the rectus, pectoralis major, and serratus magnus, with which its digitations interlace. The spaces between the cartilages are filled by the anterior third of the *internal intercostal muscles*, directed downwards and inwards, and separated from the preceding by cellular tissue, the more distinct as it proceeds backwards.

Behind the skeleton, between the cartilages and pleura, is the *triangularis sterni*, appearing continuous, externally, with the internal intercostals, and performing an important part in the fractures of the bones to which it is attached. Finally, quite

below, the anterior portion of the internal oblique and the diaphragm are also attached to the internal surface of the inferior border of the sternum.

The *arteries* are derived from the axillary, subclavian, and aorta, by means of their anterior thoracic, acromial, and internal mammary branches. The former supplies the skin, superficial cellular tissue, pectoralis major, and deep cellular layer, anastomosing with the latter.

Arising from the subclavian, opposite the vertebral artery, the *internal mammary* descends in front, behind the cartilage of the first rib, at some lines external to the sterno-clavicular articulation, and continues its course, gradually diminishing in size, as far as the sixth intercostal space. Separated from the cavity of the thorax by the pleura and triangularis muscle, to which it gives off some branches, this artery lies immediately on the cartilages, prolonged from the intercostal muscles by merely a thin layer of cellular tissue.

A ligature might be applied upon this artery, superiorly, at about three lines external to the sternum, if circumstances were to render it necessary. To expose this vessel we should cut, in preference, into the third intercostal space, as that is the largest; and divide the superficial cellular layer, fibres of the pectoralis major, thin lamellous tissue, internal fibres of the intercostal muscle, and, finally, a small quantity of cellular tissue.

From the position and size of the internal mammary, stabs in this region would produce considerable internal hemorrhage, especially when occurring close to the sternum, and the danger increases as the wound is higher. As the vessel lies at about half an inch externally, an instrument might be introduced between it and the sternum, without its being injured.

The principal branches of the internal mammary are the anterior and external. The former traverse the intercostal muscles near their sternal extremity, and run into the subcutaneous layer, where they anastomose with the branches from the axillary. In the female, one of these, ramifying in the mammary gland, is generally of great magnitude. The external, running outwards, completes the intercostal arteries, and increases in size as they descend. Finally, the trunk itself, bifurcating near the xyphoid cartilage, immediately gives off a large branch, which passes in front of this appendix, and anastomoses with a similar branch from the opposite side. These are sometimes sufficiently large for their pulsations to be distinguished through the skin, and for wounds at this point to be followed by considerable hemorrhage.

Veins.—We often find two for each internal mammary, and always one for each of the other arterial trunks. These vessels are of no importance in surgery. Those which are most superficial occasionally dilate, forming varicose cords beneath the skin, as among females affected by schirrous of the breast, also

among those who have suckled many children, or in persons whose venous circulation has been long interrupted by organic lesion of the thoracic viscera.

The *lymphatics*, placed in front of the pectoralis major, ascend to the cervical glands. The deep seated pass directly into the axilla, and communicate, among others, with the lymphatics of the cavity of the thorax. There is sometimes a gland in the fissure, separating the inferior border of the pectoralis major from the other parts. In a word, the lymphatic system is so arranged here, that blisters, issues, as well as all diseases, rarely remain beyond a few days, without affecting the glands of the neck or axilla.

Nerves.—The terminations of the intercostal branches are the only ones remarked in the inferior fourth of this region, which receives, superiorly, numerous filaments from the axillary plexus and supra-clavicular branches of the cervical plexus. These nerves are but small, and are of no consideration in operations, unless they may serve to account for the pains experienced in the neck and axilla, in injuries and diseases of the front of the chest. We have only to add, that those supplied by the brachial plexus and intercostal branches appear to be more particularly distributed to the muscles, whilst those from the cervical plexus appertain, rather, to the skin.

The *skeleton* comprehends the whole of the sternum, the sterno-costal cartilages, and sternal extremity of the clavicle.

Sterno-clavicular articulation.—The nature of the motions performed by the clavicle prevents such frequent luxation as might at first be expected. The species of capsule attaching it to the sternum, very strong superiorly, is also attached to the supra-sternal notch, and to the clavicle on the opposite side; thus presenting great resistance to its dislocation upwards.* It is true, that, at the moment of its depression, the clavicle acts like a lever on the first rib, but the disposition of the shoulder in general, and of the scapula in particular, prevents this movement being carried so far as to cause rupture of the ligaments. Posteriorly, it projects into the summit of the thorax, and corresponds, on the right side, to the termination of the left subclavian vein†, to the arteria innominata, which is separated from it by the attachment of the sterno-hyoid and thyroid muscles; on the left side, to the same vein, and to the interval dividing the left subclavian and carotid arteries. Notwithstanding this unfavourable disposition, luxations of the clavicle backwards are extremely rare; the reason being, the strength of the fibrous capsule and of the costo-clavicular ligament, and the position of the scapula. Below, no displacement can occur. In front, however, this is not the case, for here, in fact, the articulation

* The rhomboid ligament, passing from the inferior surface of the sternal extremity of the clavicle to the first rib, also prevents this accident.—H. H.

† Brachio-cephalic, or innominata.

is supported merely by the tendon of the sterno-mastoid muscle and the anterior ligament. Besides, nothing limits the motion of the acromial extremity of the clavicle backwards, whilst the shoulder is more exposed to external violence on its anterior than posterior surface. It is not, therefore, surprising, that dislocation forwards is the most frequent, and nearly the only one which can possibly occur. I say this, because the fact published by M. Pellieux is, perhaps, a unique example of luxation of the clavicle backwards.* In consequence of this articulation, all that is required to reduce luxations forwards is, as I have shown, to carry and fix the elbow over the xyphoid appendix, in such a manner that the hand of the affected side rests upon the opposite shoulder.†

The *sternum* is about three quarters of an inch thick, and rather thicker opposite the cartilages than in the intervals. In infancy it is formed of different pieces, which sometimes preserve their mobility to a later period in life, especially the two former. The first portion, also, in uniting with the second, frequently leaves a hole, filled by fibro-cellular tissue. Thus, instruments may penetrate into the chest, giving rise to serious mischief. At other times, the lateral points of ossification are not properly united in the median line. The sternum then remains bifid, in its fourth, third, or even inferior half, exposing the central organs of the thorax to injury.

The xyphoid appendix, projecting externally, presses sufficiently against the skin, in some thin individuals, to cause ulceration of this membrane. Inverted, on the contrary, it has been thought capable of interfering with the organs of digestion, giving rise to symptoms similar to those of cardialgia. Billard of Brest has recommended, that, when this occurs, the appendix should be removed. It should also be recollected, that this cartilage may incline either to the right or left side, or, in fact, in any direction; that it is sometimes obtuse, at others very acute, and occasionally bifurcated, even when the sternum is properly formed.

As the sternum, superiorly, and on the right side, is in close approximation to the arteria innominata, M. Drivon considered, that, by trephining immediately beneath, and internal to the clavicle, the artery might be immediately exposed; but this operation, easily performed on the dead body, would be attended with great difficulty in the living subject. Shielderup

* Sir A. Cooper, in his work on dislocations, also mentions a case.—H. H.

† I can scarcely imagine this to be sufficient, without other measures. In this case the extremity of the bone lies upon the anterior surface of the sternum, drawn and retained in that situation by the pectoralis major and minor muscles; consequently, unless the action of these muscles be antagonised, and the shoulders drawn back by the figure-of-eight or clavicle bandage, and the axilla properly padded, so as to separate the head of the humerus from the side, this method does not seem likely to succeed; but, in conjunction with these, the position here described is very good, and one capable of producing the desired effect.—H. H.

and Laennec have also recommended trephining on the inferior third of the left side of the sternum, in hydrops of the pericardium, as performed by some persons since the time of Riolin. It must, however, be borne in mind, that this bone is thinner inferiorly than superiorly.

Although destined to protect organs of the greatest importance, the sternum may be diseased, in a great measure disorganized, and even destroyed, without placing the life of the patient in any immediate danger. The cases cited by Galien and Harvey, where the heart might be said to have been exposed, are incontestable proofs of this fact; therefore, when pus, blood, or any other fluid has accumulated in the anterior mediastinum, and when the patient's life may be saved by its evacuation, we should, following the example of Wiel and Petit, trephine fearlessly, especially as the bone is soft and sufficiently spongy, in numerous individuals, to be easily penetrated, even with the point of a scalpel. It is in consequence of this softness, that it is so frequently diseased, that necrosis is nearly always accompanied by caries, and that contusions of the anterior of the chest are so liable to produce inflammation of a serious nature.

Susceptible of elevation and depression during respiration, being suspended to the extremities of the elastic cartilages, and, to a certain extent, flexible in itself, the sternum would appear almost incapable of being fractured, except by direct violence. However, the case published by David, in which a man, falling from a very high spot upon the ensiform cartilage, fractured his sternum by the concussion, and those cited by Chaussier and others, prove that the bone is more liable to this accident than might at first be imagined. Moreover, in cases of fracture, produced by whatever cause they may, the internal mischief should always occupy the surgeon before the fracture itself, as consolidation takes place very rapidly, in consequence of the great vitality of the bone, invested by its two layers of fibrous tissue. All that is necessary, is to retain the portions of bone in a state of immobility, easily effected by arresting the action of the intercostal muscles. Its superficial position allows of crepitation being easily distinguished, at the slightest displacement. The resistance opposed by it, to collections formed in the anterior mediastinum, is the cause of their deviating so much to point externally, extending into the intercostal spaces, the subhyoid or epigastric regions, and sometimes bursting into the visceral cavities.

Elastic and flexible *cartilages* unite the seven first ribs to the sternum; those of the last five being applied one upon the other, by the anterior extremities of their inferior borders. They are so disposed, that the first, the shortest, strongest, and the most intimately united to its two bones, opposes the idea of the first rib being really more moveable than those following. If we

examine the others successively, we find greater mobility and length, as far as the seventh, inclusive. Although the five last become gradually shorter, they are still more mobile, being merely united by means of fossæ, allowing of considerable motion, and also being much thinner; hence it follows that they are rarely fractured, whilst among the seven first this accident is of frequent occurrence. Moreover, these fractures being produced by direct blows, or by concussions, when the broken extremities overlap, the displacement is nearly always caused by the sternal portion passing in front of the costal, in consequence of the pectoralis major having acted with more or less violence upon the former, at the same time that the triangularis sterni drew upon the latter. I have, however, seen two examples of the contrary.

In cases of fracture, the only part which undergoes any change is the perichondrium. This generally becomes transformed into a bony sheath, enclosing the two fractured portions. It must also be observed, that in process of time these cartilages frequently become ossified. The same thing occurs in certain diseases of the chest; in phthisis, among others. Under these circumstances, fractures occur more easily, and callous is thrown out in a similar manner as in long bones. On the other hand, they have been known to have preserved their cartilagenous structure to a very advanced period of life, even to the age of one hundred and thirty years.

The property possessed by cartilages of bending under the action of external violence, and of again resuming their natural position, admits of the internal organs being considerably bruised, without their being necessarily fractured; thus producing inflammation and abscess, or effusion of blood into the pleura, pericardium, or anterior mediastinum. When broken, their elasticity causes them to reassume their natural position so completely, that no displacement results, although, from the nature of the injury, considerable disorganization might be expected.

The three first spaces between these cartilages are larger than those which follow. The sixth is exceedingly contracted. This is therefore one of the reasons for selecting the fifth, when we would open the pericardium according to the method recommended by Desault. At this point we are not obliged to divide the greater pectoral. The rectus muscle is extremely thin, and frequently does not ascend so high as this. The covering of the heart is not nearer at this point than elsewhere, and the internal mammary artery bifurcates below. Hence we should have to cut through the skin, superficial layer, some fibres of the great pectoral muscle, or the aponeurosis; a second layer of cellular tissue, thinner than the first; the internal intercostal muscle, an additional layer of cellular tissue, the pleura; and, finally, the pericardium. In this operation we

should leave the internal mammary artery to the inner side, and avoid the anterior border of the lungs, by pushing it outwards.

To resume. From the preceding observations, we perceive that wounds in the median line would fall directly upon the heart or large vessels, whilst those on the side may also comprehend the lungs. We must remark, in anticipation, that penetrating wounds are more dangerous in the inferior intercostal spaces, and near the sternum, than externally, in consequence of the internal mammary and its branches.

All these parts are arranged in the following order:—

1. The skin, thick and dense in the sternal depression, soft and elastic on the lateral portions.

2. The subcutaneous tissue divisible into three layers, in front of the great pectoral muscle, where it is sometimes very thick, fibrous in the median line, containing the arterial and venous branches, and nervous filaments.

3. The aponeurosis, observable in the inferior fourth only of this region.

4. The pectoralis major, a small portion of the rectus abdominalis, the principal arteries, and deep-seated nerves.

5. The sternum cartilages, and intercostal muscles.

6. Cellular tissue, and internal mammary artery.

7. The triangularis-sterni muscle, and pleura.

SECTION SECOND.

SPINAL REGION.

Limited superiorly by the posterior region of the neck, below by the inferior border of the floating ribs, or spinous process of the last dorsal vertebra, and laterally by the angle of the ribs, the posterior region of the thorax presents, in the median line, a prominent crest, depending on the spines of the vertebræ; laterally, two fossæ, or gutters, of variable depth, in different individuals; more externally, the prominence formed by the muscles, more distinct when the shoulder is carried forwards; finally, the posterior edge of the scapula, the position of which is constantly changing, with the motions of the limb, and more or less prominent, according to the conformation of the thorax. The median crest being more marked as it descends, the lateral fossæ become much deeper. The result of this is, that the spine is very convex superiorly, whilst below it inclines inversely; and that the spinous processes, at first very oblique, become nearly horizontal as they approach those of the lumbar region.

As the lateral convexity depends as much on the curvature of the ribs as on the projection formed by the muscles, it is always

augmented by crossing the arms, in front of the chest, or over the head; this should therefore be done in examination of the lungs, or other thoracic viscera, by auscultation or percussion.

The *skin*, still thicker than at the back of the neck, differs from it, by being less adherent, and by uniting more firmly to the spinous processes. It is extremely dense, a circumstance which doubtless causes the intense pain manifested in furuncula, anthrax, erysipelatous or other inflammations. It is a well-known fact, that epistaxis may frequently be arrested instantaneously, by placing a key, or other cold substance, between the shoulders. It was on account of these results that I was induced to apply mustard poultices to this region, in cases of uterine hemorrhage, either immediately succeeding labour, or occurring a few days after, which had resisted the ordinary methods, threatening speedy dissolution. These applications were attended with the completest success.

Divisible by maceration into several laminæ, the *subcutaneous layer*, dense and compact, is composed of lamellous and filamentous tissue, containing soft, reddish, elongated adipose cellules, capable of augmenting sufficiently to form a considerable layer of fat in stout or robust individuals. A few of these not unfrequently become agglomerated, and enlarging, produce tumours, sometimes of considerable size. But this can never occur in the median line, as in that situation the subcutaneous layer unites the skin to the vertebræ in a very intimate manner. Neither, for the same reason, can infiltrations, abscess, collections, and tumours of any description, excepting those depending upon diseases of the bones, manifest themselves at this point. I, however, once saw an enormous medullary tumour extending from the neck to the loins, and from one shoulder to the other. Being retained between two layers offering great resistance, abscesses form very slowly, increase in breadth, and may remain a long time before they point externally. The skin, covering them, frequently preserves its thickness, and most of its other characters, during several months. Bounded in front by the thickened aponeurosis, these collections produce considerable separation of parts, in some instances extending as far as the lumbar region, examples of which I have seen upon four occasions. In cases of this nature, the danger consisting in the density of the integuments opposing the issue of the fluids, the best method of saving the patient is to open freely into the collection at an early period.* These enormous abscesses may also occur beneath the trapezii and latissimus dorsi muscles, but they are more frequently situated in the subcutaneous tissue. I am astonished that MM. Blandin and Gerdy should have so mistaken this fact; for it is anatomically impossible that a collec-

* In the treatment of anthrax the incision should be prolonged in each direction for about half an inch, or rather more, beyond the disease, into the sound parts.—H. H.

tion, occupying the whole of the region, as in the boy mentioned by De la Motte, should be entirely beneath the latissimus dorsi or trapezius. The deep processes of the layer in question would allow of its extending to the whole of the posterior part of the trunk, the same as in effusions of blood, which nothing arrests, and which extend so easily, that we cannot open them too quickly, whilst they are circumscribed and inconsiderable.

The *aponeurosis*, thin and slight in some situations, in others is thick and fibrous. The anterior and posterior surfaces of the trapezius and latissimus dorsi are invested by a thin elastic membrane, adhering so firmly to them, that the laminæ blend and form a distinct layer, close to the inferior angle of the scapula, in the small triangular space separating these two muscles. Another process bounds the vertebral fossæ. Extending as far as the neck over the splenius, it splits to invest the serratus posticus superior*, and unites, inferiorly, on the inferior serratus, with the aponeurosis of the lumbar region, being finally attached to the spinous processes of the dorsal vertebræ and tubercle of the ribs. The aponeurosis of the latissimus dorsi may thus be considered to furnish investing membranes for all the muscles of the back, and especially a very regular lamina, separating the superficial from the deep muscles. These various membranes are too thin, and do not possess the characters of aponeurosis in a manner sufficiently marked to lead to serious mischief in inflammation of the back; but by uniting, as has been noticed, with the superficial muscles, they form a dense fascia, preventing the abscesses mentioned in the preceding paragraph from extending beneath the scapula, &c.

Muscles.—Some, large and flattened, form the superficial layer; and others are elongated, collected in a mass, and deep seated.

The inferior half of the *trapezius* represents a triangle, having its apex attached to the last dorsal vertebra, whilst the two angles of its base run to the spine of the scapula; so that, to render these muscles tense, we should bring the arms forwards. Their contractions act principally in raising the shoulder, and approximating the two scapulæ to the spine. Covered by a fibro-cellular layer appertaining to the aponeurosis, by the subcutaneous tissue, and skin, the trapezius is separated from the deep set of muscles by the rhomboid, the latissimus dorsi, and cellular tissue.

Covered by the preceding, the *latissimus dorsi*, rather firmly attached to the serratus posticus inferior, adheres to the deep aponeurosis, by soft elastic lamellæ. Emerging from the trapezius, near the angle of the scapula, it forms the inferior border of a small triangular space, of which we will speak in describing the posterior region of the shoulder, and through which an

* This is the fascia vertebralis of some authors.—H. H.

instrument might penetrate the cavity of the axilla, without dividing any other muscle than the serratus magnus. It is also by this kind of opening, that pus, &c. might pass from the dorsal region, between the side of the thorax and the serratus magnus muscle, mount into the supra-scapular, descend to the costal, or finally come from all these regions into that which we are now considering.

As the latissimus dorsi depresses the arm, carrying the inferior angle of the shoulder backwards, we must cross the arms over the summit of the head, when we would render more prominent the portion of the back which it invests.

The *rhomboid*, covering the serratus posticus superior, is prolonged from the tubercle of the ribs, by a space varying with the position of the shoulder. This space, extending between the costal portion of the axilla and the serratus muscle, communicates directly with the supra-scapular region; and as it is filled with very soft elastic cellular tissue, fluids accumulating in the lateral portion of the neck, descend with facility between the ribs, the rhomboid, and the serratus magnus muscles.

Attached to the base of the scapula, and also to the spinous processes of the last cervical, and four or five first dorsal vertebræ, this muscle can only act upon the shoulder, which it draws backwards and upwards towards the median line when it acts alone, but directly backwards when it combines its action with that of the trapezius.

The *posterior serrati muscles*, proceeding from the dorsal spines to the ribs external to their angles, act, by drawing the bony arches of the thorax backwards and outwards, the superior elevating, whilst the inferior depresses these bones. Consequently, in fractures, they tend to displace the posterior portion, by drawing it either outwards and upwards, or outwards and downwards, according to the situation of the fracture.

The *deep muscles* filling the vertebral gutters, consist of the dorsal portion of the semi-spinalis, sacro-lumbalis, longissimus dorsi, transversalis colli, complexus splenius, and trachelo-mastoideus. Divided from the superficial muscles by the aponeurosis of the posterior serrati, they merely act upon the spine and posterior extremity of the ribs. This is also a reason why pus escapes with so much difficulty, being obliged, when it arrives beneath the superficial layer, to extend either to the side of the axilla or into the costal region, instead of pointing directly through the skin.

The *levatores costarum* muscles, descending obliquely outwards from the external part of one costo-transverse articulation to the subjacent rib, are prolonged to the second. Their use, as their name implies, is to elevate the ribs. In fractures they assist the serratus posticus superior in counteracting the action of the inferior serratus, and external fasciculi of the longissimus dorsi. As to the *intercostals*, they present no point of importance.

Independent of the intercostals, there is no artery of sufficient size to give rise to any hemorrhage of consequence, in wounds of this region. The *cervicalis-descendens*, coming from the subclavian, ramifies in front of the rhomboid muscle, generally giving off a branch to the superficial muscular layer before anastomosing, in the latissimus dorsi, with the sub-scapular artery, thus forming an arch, uniting the subclavian with the brachial. Each intercostal artery furnishes a branch, which passes between the bodies of the vertebræ, the inferior costo-transverse ligament, and two transverse processes, to ramify between the sacro-lumbalis and semi-spinalis muscles, where they divide. One of their branches approaches the median line running towards the skin; the other, on the contrary, passes between the sacro-lumbalis and longissimus dorsi muscles, and terminates in the subcutaneous tissue. Finally, the intercostal artery itself, enlosed in the space of the same name, does not, in reality, reach its groove of protection until about the angle of the rib. Opposite the apex of the transverse process it is sufficiently far from it, to be liable to injury from any cutting or pointed instrument. Let us here, as in many other points, admire the disposition of the parts; for as the mass of muscle, protecting this artery posteriorly against external bodies, becomes thinner and thinner as it proceeds outwards, the artery at first free beneath the rib, immediately approaches it so closely as to lie completely on its internal surface.*

The *veins* accompanying the arteries, all empty themselves into the azygos veins by the intercostals, and into those of the arm and neck by the cervical and subscapular. The *azygos dorsale*, described by Godman, arising by two lateral roots, at the inferior part of the neck, is prolonged from the basilar artery as far as the loins, and is the only one which would merit any attention if it were regular.

The *lymphatics* of the deep layer run, for the most part, into the glands of the axilla. The superficial nearly all pass into the supra-clavicular region. According to this arrangement, diseases of the skin and cellular adipose layer react more particularly upon the glands of the neck, whilst affections of the deeper seated produce swelling of those of the axilla.

Nerves.—Besides the spinal accessory, lost in the trapezius muscle, some filaments of the deep branches of the cervical plexus, prolonged to the rhomboid, and other filaments, derived from the brachial plexus, the dorsal region also receives the posterior division of the spinal nerves. These latter follow the arteries, dividing like them, and ramifying in the superficial layer of the skin; the intercostal nerve, inferior to the artery, lies equally beneath the edge of the rib, sometimes dividing before it leaves the dorsal portion of the thorax.

* In consequence of this arrangement, the trocar, in paracentesis thoracis, should be introduced upon the upper border of the rib.—H. H.

Skeleton.—The *dorsal vertebræ* are so disposed, that their bodies, extended more in the antero-posterior direction than transversely, form a kind of column, concave in front, projecting into the thorax. This *anterior concavity* dependant on the vertebræ, and their interarticular fibro cartilages being thicker posteriorly than anteriorly, is subject to almost endless varieties. In newly-born infants it scarcely exists, in old persons it is generally very decided, less marked in females than men, and in those persons who habitually hold themselves upright, than among those who stoop; it may be considerably increased, or altogether obliterated from the effects of rachitis. In the former case there is humpback, with the sternal region more or less depressed; in the latter, the dorsal region appears beaten down, and the sternum is more or less thrown forward.

There is another *curve* on the *left side*, and in the superior third of the column at the spot where the aorta lies in the thorax. Varying less than the preceding in the natural state, it perhaps more frequently exceeds its proper limits in rachitis, and concurs, in a great measure, in the production of lateral curvatures. The formation of these curves is, in other instances, very simple, and completely mechanical, depending on the weight of the body, and on the action of the muscles. The head being heavier anteriorly than posteriorly, the posterior muscles, to maintain the proper equilibrium, remain almost permanently in a state of contraction, thus, in a great measure, causing the vertebral column to project forwards in the cervical region. The weight of the thoracic viscera on the one hand, the weight of the head and neck on the other, tend to draw the upper extremity of the chest forwards; but as the centre of gravity contributes to project the base, the mass of the sacro-lumbalis and longissimus dorsi muscles react strongly on the two inferior thirds of the spine in the dorsal region, thus producing the convexity perceived in the upper part of this region.

In the ordinary actions of life men employ the *right* superior extremity rather than the left. Thus, whilst the several muscles of the right shoulder draw upon the corresponding portion of the spine, those of the opposite side, filling the spinal groove, tend to approximate the cervical and last dorsal vertebræ, accommodating the central line of the body to this position. Hence the lateral curvature attributed, before the time of Beclard and Bichat, to the position of the arch of the aorta.

Let us now apply this arrangement to pathological curvatures, and we shall then understand in what direction they most frequently occur, also the importance of mechanical remedies when there is no disorganization.

In these deviations, the spinal canal is flattened, but not in reality contracted. Thus they may proceed very far, without compressing the marrow, whilst in Pott's disease, where the protuberances depend upon caries of one or more bones of the

vertebræ, paralysis generally ensues at a very early period. Here, in fact, the bone very rarely becomes disorganized, sufficiently to produce obliteration of those above and below, without equally affecting the spinal marrow. We should remark that in Pott's disease the curvature is more acute, and nearly always backwards, whilst in those depending on mollities ossium, it is more prolonged, sigmoid, and situated laterally. We can thus understand the advantage of lateral extension, so much recommended by M. J. Geurin and others, in some cases, whilst in others, this, and similar methods would lead to serious mischief.

The spinous processes of the dorsal vertebræ, horizontal superiorly, inclining and imbricated in the middle, and again horizontal inferiorly, the spine in the first and last of these situations enjoys a considerable degree of mobility, whilst in the other it is nearly deprived of it.

Superficial, and solidly united to the skin, it is easy, in tracing them with the finger, to discern any deviations of the column; but it should be remembered, that some of the bones may incline and project more than ordinary, without any actual disease being present. Their position also exposes them to concussions and fractures, and allows of their being removed with facility; and the laminæ descending one behind the other completely prevent the entrance of instruments into the spinal canal.

The articular processes of the vertebræ, very oblique, nearly perpendicular below, are so disposed that the inferior, placed behind the superior, look forwards and outwards, strongly opposing luxations without fracture, and permitting of distinct flexion whilst they limit extension. The transverse processes are remarkable for their thickness, length, and more particularly for their direction backwards, thus augmenting the depth of the vertebral fossæ externally, and of the thoracic excavations internally.

The *spinal canal*, narrow, nearly cylindrical, here furnishes the nerves to the thoracic and abdominal parietes, the lower extremities, and a branch to the brachial plexus; consequently, injury to the marrow, between the second and third dorsal vertebræ, would not paralyze the superior extremities, and as these nerves pursue a more oblique course towards the intervertebral foramina in approaching the loins, the mischief must occur towards the seventh or eighth before the nervous influence in the legs would be suspended.

The power of the *supra* and *inter-spinal*, *yellow*, *anterior and posterior vertebral ligaments*, and more especially of the intervertebral fibro-cartilage, joined to the disposition of the bony surfaces, almost completely prevent dislocation of these bones. Fractures are also rare for the same reason, and from the soft parts and ribs diminishing the force of external violence, directed against the vertebræ.

The *ribs* are always much curved in this region, varying in this respect, however, with age and individuals. In the infant they are much less so, in proportion, than in the adult. The chest also appears compressed on its sides, in the earlier period of life. This depression is sometimes excessive in young scrofulous subjects. Dupuyilen considering that it was frequently produced by hypertrophy of the amygdalæ, recommended the excision of these glands. When this disposition remains after puberty, the scapulæ commonly project more backwards, giving rise to the cognomen of chicken breast. The ribs then appear drawn up under the shoulders. This condition has generally been considered as predisposing to phthisis.

Applied over the whole of the anterior surface of the transverse processes, we can scarcely conceive that the posterior extremities of the ribs can be dislocated. If pushed with sufficient violence backwards, they would be fractured towards their angles, before the costo-vertebral and inter-transversales ligaments would yield. If the violence were directed from behind, the power of the costo-transverse ligament, and the hold taken by the heads of the ribs upon the vertebræ, would also cause them to be more easily broken than luxated. Finally, we are in possession of no authentic example of this kind of displacement, as that reported by Bartlet is not sufficiently conclusive to lead to conviction.

The *intercostal spaces* are narrow in the dorsal region, especially where they approach the vertebræ. This is a reason against operating here for empyema. Other motives should also deter the surgeon. The thickness of the soft parts makes the operation very difficult. The intercostal artery and nerves are here largest, and unprotected by the rib. I must, however, remark, that between the angles of the ribs and sacro-lumbalis muscle, these spaces are covered only by the latissimus dorsi, trapezius, or serrati postici, and that, through here, the deepest point of the pectoral cavity may be penetrated. It is also at this spot, that certain aneurisms of the aorta present externally.

As the ribs are not all sustained by the sternum, and the five last are but weakly united to each other at their anterior extremity, we can imagine that the superior are more easily fractured than the inferior. This seldom occurs in this region from direct violence, as they are padded posteriorly by the soft parts, neither are they very commonly broken by concussion, as, notwithstanding the great curvature of their angles, the ribs snap more frequently anteriorly, where they are thinner and not so well supported as posteriorly.

The dorsal region sometimes possesses a rib too many on each side, occasionally at its upper or lower portion. In the former case, the cervical region is deprived of its last vertebra, the costiform prolongation, constituting the supernumerary rib. In the latter, the first lumbar vertebra acts in a similar manner.

Not unfrequently, this excess of formation depends upon the existence of an additional vertebra, as columns, consisting of five and twenty bones, are by no means rare. I have met with three; and MM. Cuiveilher, Berard, Blandin, Monod, besides numerous other anatomists, have mentioned similar peculiarities. We ean understand the mistakes likely to ensue from this anomaly.

In reviewing the different parts, from the exterior to the interior, we find them in the following order:—

1. Skin.
2. Subcutaneous layer.
3. The fibro-cellular membranes, uniting below to form the aponeurosis, and enclosing the trapezius, latissimus dorsi, rhomboid, and serrati postici muscles.
4. The deep muscles.
5. The vertebræ, ribs, intercostal muscles, arteries, and nerves.

SECTION THIRD.

COSTAL REGION.

The lateral region of the thorax is double, and may be divided into two portions on each side, one superior, entering into the axillary, the other inferior, forming the proper costal region. The latter presents at its upper part the prolongation of the two borders of the axilla, separated by the excavation commencing the cavity of that region. One of these borders, supporting anteriorly a portion of the mammary gland, extends as far as the sixth rib, leaving a depression beneath it, termed *submammary fissure.* The other descends obliquely backwards, and may be distinguished as far as the floating ribs. In the strong muscular subject, we remark, between the preceding, digital eminences, indicating the insertions of the serratus magnus. Finally, we perceive by the touch in individuals, who are not excessively stout, the bones, the intercostal spaces, and the apices of the twelfth and eleventh ribs, when they are free, in the walls of the abdomen.

The *skin*, deprived of hair and furrows, encloses a large quantity of follicles, as in the preceding region. Posteriorly, its thickness is great, anteriorly, it is thinner. Its characters are a melange of those of the skin in the dorsal, abdominal, and sternal regions. Less adherent to the subjacent tissues, than in the dorsal, it is easily displaced, and is very elastic. Thus, wounds, with loss of substance, unite better here and more quickly. We take advantage of this mobility in the operation for empyema, when we would prevent the admission of air into the diseased cavity.

In thin individuals, the *subcutaneous layer*, thin, although very distinct and lamellous, is sometimes, on the contrary, of sufficient thickness to prevent the intercostal spaces from being recognized through the skin, and extends in one direction between the greater pectoral muscles and the ribs, and in another, in front of the latissimus dorsi to the cavity of the axilla. Hence, diffused inflammations and idiopathic abscesses may occur with equal facility, and pus extend to this region from several others, especially the axillary and dorsal.

The *aponeurosis*, very thin, rather cellular than fibrous, at first well marked on the external surface of the external oblique, where it is continuous with the aponeurosis of the abdomen, ascends single, and gradually becoming thinner, over the serratus magnus, as far as the axilla. Anteriorly and posteriorly, it lies on the deep surfaces of the greater pectoral and latissimus dorsi, and enveloping their borders, is thus prolonged to the anus.

On account of this fascia, and the intercostal spaces, subcutaneous depositions easily become deep seated abscesses, and reciprocally intermuscular suppuration, and that occurring in the cellular tissue external to the pleura, present in the form of large diffused abscesses, between the axilla and the hypochondriac regions. I have seen several of these cases also noticed by M. Meniere.

Muscles.—Several merely lie upon the ribs; we will examine these first. Anteriorly, is a portion of the pectoralis major, descending as far as the sixth or seventh rib, and posteriorly, the most important part of the latissimus dorsi. The latter is so disposed, that its costal digitations run almost directly to the angle of the scapula. Being inserted into the humerus, it may either lower the arm, or raise the four inferior false ribs, tending to draw them upwards and outwards when fractured. Thus, in the attempts at deep inspiration, the arms are raised almost instinctively to take a firm hold on any neighbouring object. Inferiorly and anteriorly, are the dentations of the external oblique, attached to the seven last ribs, where they interlace with those of the preceding, and especially with the digitations of the serratus magnus. All its points of insertion, being obliquely forwards, downwards, and inwards, sufficiently indicate the direction of the bones supporting them. In consequence of the disposition of the ribs, the *external oblique*, one of their most powerful depressors, can raise the pelvis or make the aponeurosis of the abdomen tense only in the same degree as the other muscles have previously fixed the chest. In the space circumscribed by the three preceding, we find the inferior dentations of the serratus magnus nearly parallel in direction to that of the ribs. In abandoning the angle of the scapula, the last of these dentations leaves between it, the rhomboid and latissimus dorsi, a space, a kind of opening already mentioned in the dorsal region, as extending between the shoulder and the thorax,

forming a communication between the subcutaneous cellular tissue and the supra-scapular region, allowing pus formed on the lateral parts of the neck to extend beneath the scapula, and form abscesses at the base of the costal region. Lastly, we have the serratus posticus placed beneath the latissimus dorsi, and covering but a small portion of the costal region.

The other muscles of the side of the chest, enclosed in the intercostal spaces, form two planes, crossing each other nearly at right angles. The external is directed obliquely downwards and forwards; the internal, on the contrary, descends backwards. They are separated by cellular tissue, occasionally enclosing fat.

Internally, their fibres may be seen through the transparent pleuræ, isolated from them by thin lamellous cellular tissue, in which fat is sometimes developed. This may push the pleura inwards, producing the floating free appendages frequently observed in the thorax of old persons. Externally, a thin fibrous lamella, extending from the surface of one rib to the other, separates them from the superficial muscles, and appears to mingle with the fibrous bands naturally blended with the fleshy fibres. These two muscular planes exist throughout the costal region, the external in the dorsal, and the internal in the sternal section.

Arteries.—The intercostal is the only artery which merits any attention, from its size and position, relative to the operation for empyema, on the one hand, and to penetrating wounds of the thorax on the other. Situated between the internal intercostal muscle, and the cellular tissue dividing it from the external, it runs to the groove presented on the internal surface of the inferior border of the ribs. Proceeding for some inches, thus enclosed in a canal, muscular internally, and osseous externally and posteriorly, we may as it were scrape the rib, as far as the middle of the side of the thorax, without injuring it.

It then becomes more and more isolated, terminating beneath the border of the rib. Afterwards, advancing towards the sternal region, it loses much of its volume, and anastomoses with the external branches of the internal mammary.

In its course, the intercostal gives off numerous branches, met with on the external surface of the corresponding rib, and traversing the deep muscles, to ramify in the superficial; one among these ought to be mentioned. This, separating from the trunk near the middle of the space, runs obliquely forwards as far as the upper border of the inferior rib, and supplies the external muscle. Its origin is very variable, so much so, that it may be injured in paracentesis thoracis, but it is fortunately too small to produce serious hemorrhage.

The condition of the intercostals in the female, mentioned by M. Floret, would always lead to this accident. In this case, the three first arteries of the left side presented numerous small true aneurisms. Their trunk being in general much closer to

the pleura than the superficial muscles, they are reached more easily the nearer they approach the anterior region. Thus, to avoid wounding them, it is the custom to penetrate the chest in front of the angle of the ribs. In these operations, we should divide the tissues opposite the upper border of the rib, and recollect that, in certain diseases, the secondary arterial branches may increase considerably, to even triple their ordinary size. From the position of these vessels it follows, that they may be opened, in the operation for empyema, simple puncture, penetrating wounds, in opening abscesses, and, finally, by splinters of fractured ribs. In all these cases, whether there be a wound or not, it is nearly impossible to seize and tie the artery; neither can it be compressed with more facility; and the blood flowing almost constantly into the chest, rather than externally, produces serious consequences.

Hence, it is evident, that the various methods adopted by Gerard, Goulard, &c. of passing a thread round the rib, in order to secure this vessel, should be rejected, more especially as they have been advantageously superseded by that recommended by Desault or Sabatier, consisting of a small linen bag filled with tow, which prevents its exit across the intercostal space. In this manner compression is made equally on the two extremities of the artery, causing less pain to the patient. The other arteries of the costal region being, for the most part, branches of the preceding, anastomosing, superiorly and anteriorly, with the subscapular, or external mammary, and superiorly and posteriorly with the scapular branch of the descending cervical, ramify in the superficial muscles, cellular tissue, and skin; naturally of insufficient size to be really of importance in a surgical point of view, unless with regard to the communication which they establish between several remote points.

The *intercostal veins* are disposed precisely in the same manner as the arteries.

The two planes of *lymphatics* follow different directions. The superficial ascend to the glands of the axilla, whilst the deep proceed, accompanying the blood vessels, from the intercostal spaces to the side of the spine, or to the glands of the anterior or posterior mediastinum. Thus, diseases of the skin, or superficial layer, frequently implicate the axillary lymphatic glands, without interfering with those of the interior of the thorax, whilst the latter are commonly affected by deep-seated lesions. A blister, for example, applied on the costal region, produces pain and swelling in the cavity of the axilla. Sarcoma, or caries of the rib, on the contrary, would re-act behind the sternum, or on the anterior of the spine.

Nerves.—The serratus magnus muscle, receiving its nerve from the fourth and fifth pair of cervical, might retain its action, although the spinal marrow were injured at the upper part of the dorsal region. As this nerve merely supplies the serratus,

its destruction would naturally lead to the paralysis of this muscle, as I think I have seen happen in three instances.

The posterior border of the shoulder then remains prominent and moveable like a bird's wing. There is neither pain nor inflammation, and the patient has scarcely any use in the limb. There are also some branches furnished by the brachial plexus to the latissimus dorsi and pectoralis major.

The proper nerves belonging to the costal region are the *intercostal*, nearly equal in size to the artery. Each of them divides in a similar manner, accompanying and remaining beneath it, so that the traumatic opening of the vessels almost for a certainty indicates the division of the nerve. However, it descends, rather more than the artery, in the space filled by the muscles, crossing the internal surface of the last rib. The last, especially, considered by some persons as the first lumber branch, separates from the bone to ramify in the intervals between the muscles of the walls of the abdomen.

Formed by the bodies of the seven last ribs, the *skeleton* is remarkable from the disposition of its bones, and their relation with the organs which they surround. The ribs, externally, are covered by large muscles; internally, they are merely invested by the pleura. Their fractures, therefore, produced by violence, tending to increase the curvature, are accompanied by displacement, and mischief, of greater or less importance, according to the situations in which they occur.

Fractures.—Thus, in the course of a curved line, corresponding to the insertion of the serratus magnus, this muscle draws the posterior fragment upwards, outwards, and backwards; whilst the external oblique carries the anterior portion of the bone in an opposite direction.

When more posterior and higher, the latissimus dorsi and serratus magnus, acting on the anterior, tend to make it overlap the posterior, and the consequent displacement is very considerable. Towards their anterior extremity, the overlapping is more difficult, because, at the same time that the serratus magnus inclines one of the bony pieces outwards, the pectoralis major draws the other in the same direction, and it is, in addition, acted upon by the transverse muscles and the diaphragm, which incline it downwards and inwards. However, as most of the muscles are similarly attached to a great portion of the external surface of the ribs, this displacement is rarely carried to any extent; inasmuch as the sternum, on the one hand, and the spine, on the other, equally oppose it, maintaining the broken extremities in apposition, through the means of those ribs which remain sound. It is not, therefore, on this account, that fracture of the ribs is ordinarily dangerous, but, rather, from the nature of the organs which may, at the same time, be injured. In fact, if it be direct, the pleura, lungs, as well as the intercostal nerves and vessels, may be stretched or torn; whence

effusions and inflammations of the chest, and emphysema. If it be by concussion, the fractured portions tear the external soft parts, whence the pain, so remarkably augmented in respiration. Finally, when the fracture is comminuted, the splinters may wound either the lung, the intercostal artery, or the external organs, or all these parts simultaneously.

The *true ribs* would be more easily fractured, as they are higher, shorter, and less flexible, were it not that the shoulder, arm, and muscles prevent this, by protecting them in a most efficacious manner through the whole of the axillary portion, whilst, inferiorly, they are uncovered, and exposed to the action of foreign bodies.

When only one rib is broken, the displacement always occurs inwards, as it can only be produced by the cause of fracture; these isolated fractures are generally caused by gunshot wounds, which, however, most frequently give rise to more extensive mischief. If the projectile strikes the edge of the rib, it deviates, traversing the intercostal space and chest. If, on the contrary, it falls in the centre of the external surface, the bone may yield without breaking, and cause the foreign body to alter its course, skirting the walls of the thorax, from before backwards, or from behind forwards, without either producing fracture, or penetrating the cavity of the thorax.

The ribs are flattened, and so firmly fixed, that a knife or sword may cut parallel to their length, without fracturing, or, at least, more than slightly splintering them. The *intercostal spaces* are not all of the same size; the third is the largest, the first and second rank next, the fourth, fifth, sixth, and seventh differ but little from each other; the two last are larger, but less important. These variations, more evident in the anterior half of the chest, and the gradual enlargement which takes place from behind forwards, are caused by the ribs at first descending, and, subsequently, ascending. It is at the union of the two anterior with the posterior third of the space between the sternum and the spine, that it has been recommended to puncture the chest for the evacuation of fluids, as at this point surgeons considered, that the artery was less exposed to injury, being covered by the rib, and that the fluid would escape more readily.

Although, in cases of necessity, we could perform the operation for empyema indiscriminately, in all and any part of the intercostal spaces, there are some which we should avoid. We do not operate on the five or six first, because they are covered by the scapula, or the great pectoral muscle, and fluids do not accumulate at the upper part of the chest. Neither do we select the two last, because, the diaphragm ascending naturally against their internal surfaces, the instrument may penetrate through it into the cavity of the abdomen. The anterior third of these spaces is objectionable, notwithstanding it is largest, first, because

the arteries are, with difficulty, avoided; and, secondly, because the fluids ordinarily accumulate more posteriorly, and especially because this cannot be rendered the most depending point. And we avoid the posterior portion, as there we are obliged to cut, transversely, sometimes the trapezius and serratus posticus inferior, and always the latissimus dorsi; moreover, at this point, the space is narrower, and the vessels and nerves less protected by the rib.

Thus, in evacuating fluids collected in the thorax, it is better to penetrate anterior to the latissimus dorsi, between the cavity of the axilla and the anterior of the last intercostal space. Verduc and others recommend between the tenth and eleventh rib, on either side, indiscriminately, because this space corresponds best to the point at which the fluids accumulate. But, as the diaphragm is pushed up, on the left side, by the spleen, and by the liver on the right, Garengeot and others preferred the eighth and ninth.

It would be imprudent to operate lower on the right side, not only on account of the diaphragm rising as high as this point, but, also, because it may form adhesions with the walls of the thorax, in which case the instrument would most probably penetrate the abdomen. Laennec, who witnessed this accident, remarks that the diaphragm sometimes ascends as far as the sixth, and even the fifth true rib; and he considers that, generally speaking, the operation might be more advantageously performed in the centre of the chest, inasmuch as in females, and in most men, this is really the most depending point, when the patient lies horizontally, a little on the side. Mr. S. Cooper, for the same reason, recommends the space between the sixth and seventh true rib.

Whatever these various opinions may be, the best spot for paracentesis thoracis is easily decided. We can, if I am not greatly deceived, perform it, with nearly equal advantage, on the third, fourth, fifth, and sixth intercostal spaces. Here we need only divide the skin, adipose layer, the membrane covering the intercostal muscles, and the pleura. By following the direction of the ribs, the digitations of the serratus magnus and latissimus dorsi require only to be separated, when the opening is made immediately in front of the latter muscle. The artery will then be avoided with facility, as it is almost completely covered by the rib.

Surgeons have recommended much precaution in opening into the pleura, lest, as they observe, the lung be wounded. It appears to me, that the fears, upon which they ground this advice, are chimerical, or, at least, have little foundation. If the lung has no adhesion, it is quickly pressed out of the way by the air entering the chest through the external wound. If, on the contrary, it adheres to the pleura costalis, it will be wounded in spite of all precautions. Besides, what danger would result from such an

accident? In my opinion, this operation, instead of being complex and minute, may be reduced (when the situation has been properly selected), to a simple incision, as in opening any deep-seated abscess. When the operation is really indicated, there is commonly some fluctuating spot, marking the point of opening. And when this is not the case, the intercostal spaces are so much enlarged, that it will be quite sufficient to introduce the instrument into the widest, without fear, as regards the lung.

Hernia pulmonalis.—After the operation for empyema, or after penetrating wounds of any description, the intercostal muscles, divided transversely in retracting, leave an opening through which the lung may protrude, and form a tumour externally.* The observations of Ruysch, &c. support this assertion. A wound in the anterior third of the five inferior spaces would penetrate the abdomen, rather than the thorax, in which case some abdominal viscus might protrude. In 1835, I removed an omental tumour, of the size of an egg, which had formed in the seventh intercostal space, subsequent to a wound of this nature. It may also occur, that the external parts only cicatrise. The lung would then form hernia beneath the skin, especially during inspiration. Sabatier has published a remarkable example of this, and I myself also witnessed, in 1821, one, still more remarkable, in a man, about fifty years of age, who died at the Hôpital St. Louis, having, nine years previously, had several ribs broken. The middle portions of the fifth, sixth, and seventh had disappeared, leaving a space, capable of lodging a fist, through which the lung protruded beneath the skin when he breathed, or at any exertion. The patient's health, in other respects, was good.

Some subjects have such large ribs, that several of them unite. I have seen them all united by their margins; a circumstance of great safety, as regards penetrating wounds. When they are weak they, on the contrary, bend under violence, producing internal disturbance, without breaking or leaving any traces externally. Finally, their fractures most frequently occurring at the extremities of the great diameter of the chest, account for the necessity, when there are several, of augmenting the opposite diameter by the aid of graduated compresses, and a bandage placed round the body. It is thus that motion is prevented, when we would consolidate the thorax, and cause respiration to be performed by the diaphragm.

* This, in empyema, may always be avoided, by merely dividing the integuments with a scalpel, and completing the operation with a trocar.—H. H.

SECTION FOURTH.

MAMMARY REGION.

The mamma, scarcely existing in man, does not lead to any particular consideration. In women, on the contrary, it is an important region, varying in size, form, and density, according to age, constitution, &c.

Representing two half spheres on the anterior of the chest, regularly rounded and firm in young virgin females, the mammæ are soft, pendant, and more or less flattened in those who have borne several children. Sometimes they form a considerable prominence; sometimes, on the contrary, they are scarcely distinguishable, depending upon their intrinsic volume, or the quantity of cellular tissue enveloping them. Their number is far from being constant. A man presented himself, in 1832, at the Hôpital de la Pitié, having a third close to the epigastrium. M. Robert, of Marseilles, speaks of a female who had one on her thigh; supporting the cases of multiplied mammæ, cited, in older times, by Valée and Cabrol, and refuted by Portal, who asserted that the supernumerary gland is always a division of the natural organs.

Fine, thin, soft to the touch, white or slightly bluish, before the woman has experienced venereal enjoyment, the *skin* of the breast is uneven, covered with wrinkles, thicker, and less white in those who have frequently been mothers, or among those of a certain age. In the centre it is surmounted by the nipple, a species of homogeneous spongy body, erectile, extremely sensible, of a reddish or brownish colour, perforated by the numerous orifices of the lacteals, and surrounded by an areola generally of a colour analogous to that of the nipple. Here, this membrane enjoys but little elasticity, and encloses a considerable number of sebaceous follicles. Thus, it frequently chaps during lactation.

The proper tissue of the nipple is homogeneous, the elements of which it consists being so blended that they are with difficulty distinguished. It is, therefore, doubtful whether Ruysch has ever succeeded in tracing nervous filaments to the cutaneous papillæ. Reposing on a rounded mass, endowed with a certain degree of elasticity, we can conceive that it may be prolonged by suction or cupping-glasses, when too short or broad for the infant to catch it; that it may also serve as a support for the artificial mamma, when, either from disease or malformation, it will not bear the suction of the infant. Its homogeneous texture, and great degree of irritability, explain the frequent excoriations and various degeneracies. Its functions and position, exposing it to the mechanical action of external agents, in their turn predispose it to become the seat of cutaneous cancer.

The *subcutaneous layer* differs from that of the regions previously examined, by its greater degree of thickness; by its adipose cells, which are more abundant and larger; finally, by its enclosing the mammary gland. Its cellular tissue is rather filamentous than lamellous. Several of its septa, firmly attached to the interior of the skin, extend through the secreting organ, thus arriving at its deep surface.

Its *arteries* appertain to the internal mammary, intercostal or anterior thoracic, and to the external mammary or inferior thoracic. The last is the largest. Its principal branches are found externally beneath the edge of the pectoralis major, and are divided in amputation of the breast, frequently giving rise to considerable hemorrhage. The branches of the former, ramifying on the side of the sternum, become superficial. The second supplies the upper portion. By anastomosing, these several arteries form a plexus, disposed in such a manner that extirpation of the gland is but rarely succeeded by dangerous hemorrhage, where the disease has caused no preternatural dilatation. We must, therefore, expect, in this operation, to meet with arteries increased not only in size but number, when the tumour is large and of long standing. It should also be remembered, that they are principally situated at the upper part, internal or external to the wound, the inferior half of which ordinarily presents merely small ones, and that lodged in the cellulo-adipose layer they promptly recede, thus rendering the ligature difficult; whence the recommendation, by some surgeons, to secure them as they are divided.

Veins.—Some are disposed like the arteries, which they surpass in volume, and to which they in general adhere, making their separation difficult. Others, placed beneath the skin and in the gland, form a kind of plexus in women who have suckled infants. Proceeding from this point, the veins of the breast are of sufficient size to be discerned through the skin. They occasionally become varicose in females of a certain age, who have been mothers, or who are affected with chronic enlargement of the organ, &c. These, enlarging in schirrous, produce that disagreeable appearance which has been always observed, and which has been compared by the ancients to a crab (*cancer*) placed upon the organ to devour it. The veins of the glandular tissue have very thin walls, and nearly all go to those of the axilla; some running to the internal jugular or subclavian, internal or external to the sterno-mastoid muscles, may be torn in fractures of the clavicle, causing considerable ecchymosis.

The *lymphatics* of the breast are similar to those already described in the costal, axillary, and sternal regions; they communicate, on the one hand, with the glands of the anterior mediastinum, and with those of the axilla; on the other, with the glands of the sub-hyoid and supra-clavicular regions.

Nerves.—The supra-clavicular filaments of the cervical plexus traverse the skin, and the superficial laminæ of the cellular whilst the thoracic branches of the brachial plexus are distributed through the gland and cellulo-adipose tissue. The corresponding intercostal branches are equally lost here, after traversing the muscles, but they are so small that their diseases are little understood; however, analogy and some facts lead us to consider them the cause of much of the pain experienced by females, when there is no apparent affection of the breast.

The *mammary gland* is so ill defined, that some portion may be left unobserved, even when the extirpation of the whole has been intended. Its superficial or anterior surface, unequal, rugged, convex, is separated from the skin by a layer of adipose cellular tissue, increasing in thickness the further it is from the nipple. Its deep surface, is, on the contrary, smooth and flat, invested by a fibrous layer, separated from the great pectoral merely by cellular tissue. Its divers lobules are united by membranes which harden, becoming fibrous, and sometimes ossified, in certain cancers. Those layers, prolonged into the skin, allow of the formation of pus at many distinct spots; and when abscesses of the gland are manifested in the breast, it is by no means uncommon for them to present themselves in several distinct collections, each requiring to be opened separately. In gelatinous, hydatid cancer, &c., these intersections are principally instrumental in producing the lobulated disposition, constituting their principal characters.

Not being prolonged to the muscles, they generally terminate in the cellular tissue investing the posterior surface of the gland. On the contrary, they can be traced towards the adipose tissue, under the form of branches, extending in all directions, forming, as it were, the roots of the cancer.

Thus, divided by nearly bloodless lamellæ, and consisting of elastic, firm, white tissue, almost deprived of visible blood vessels, the breast, performing functions into which chemistry enters to a considerable extent, is rarely attacked by intense inflammation, or true phlegmonous suppuration. Its texture accounts for the pain accompanying any acute affections, induration, and alteration, to which the breast is so liable.

The greater degree of vascularity of this organ, combined with the absence of all function, assimilate it more to the other tissues in man. Thus, phlegmonous indurations most frequently assume the subacute form, terminating commonly in resolution. However, as the same elements enter into it, cancer occurs occasionally in man, as in the female.

The small glands bounding the circumference, being, as it were, lost in most females in the cellular tissue, sometimes swell, producing pain at each menstrual period, or at various times, between forty and fifty years of age. These must not be mis-

taken for the tumours described by Colles*, neither do they appear to me to be in the slightest degree connected with cancer.

Tumours of the breast may descend as low as the depression separating the lower margin of the greater pectoral from the ribs, consequently, in extirpation, lest we divide this muscle, we must dissect the parts from above downwards. To avoid the cicatrix or wound being dragged upon, the incisions are better made parallel to the muscular fibres, from above, downwards and inwards. During the after-treatment, the arm should be confined, for the same reason. Finally, when the disease compels us to penetrate as far as the ribs, the fasciculi of the pectoralis major, which remain untouched beneath the cicatrix, endow the corresponding limb with much greater perfection of motion than would at first be imagined.

Lacteals.—Arising in the lobules of the gland, like all excretory ducts, by numerous radicles, some, according to Haller, also commencing in the adipose layer, the *lacteals* open on the surface of the nipple. Several are so close to the skin, and so large in some women who are suckling, that a small incision or wound in the neighbourhood of the areola, may remain fistulous during the period of lactation. As they are the special seat of the disease known by the term of enlargement of the breast in lying-in women, it appears, in reality, in this, that the milk is coagulated, and, becoming a foreign substance, irritates, by its presence, producing inflammation of the surrounding cellular tissue. It is according to this idea that the ammoniacal liniments have been recommended, with the intention of reducing the milk to its natural fluidity. This application is frequently attended with great benefit.

Practical remarks.—The mammæ is composed of a proper tissue, the seat of its principal maladies, of a fibro-cellular structure, the ordinary situation of mischief in several of its deep-seated affections; lastly, of cellulo-adipose tissue, which appears destined for its nourishment, and protection against external

* Colles, at page 128 of his Surgical Anatomy, has the following description of these tumours. He says, "This is a tumour, or hardness of the breast, generally "seated deep in the substance of the gland, and towards the axilla. This is usually "traced, by the patient, to some slight hurt. In size, it scarcely ever exceeds a "walnut. Its surface seems rough; but this is caused by its being felt through the "gland. It is occasionally attended with some slight pains; these are induced by "any distress in mind, by wearing clothes tight across the breast, and by a costive "state of the bowels. On the approach of the menstrual period, these pains increase, "and cease on this evacuation being completed. A temporary enlargement of the "tumour attends these attacks of pain, and retires on their cessation. The subjects "of this complaint are young women generally under thirty. In one instance, the "patient was nearly forty years of age, and unmarried; in another, the lady was married, but had not any children, and was irregular in menstruation. These tumours "disappeared in such of these patients as became nurses, and in the others, have remained stationary for many years. The only treatment, I conceive, they require, "is such as tends to restore the general health."—H. H.

violence, and in which its abscesses and phlegmonous inflammations commonly occur.

When suppuration commences in the cellular tissue, it easily invades the whole mass, both anteriorly and posteriorly, in consequence of its elasticity and porousness. As the gland then remains untouched, the large cysts which result generally close up very quickly after being emptied.

Near to the nipple, the thinness and filamentous condition of this tissue, and the delicacy of the integuments, prevent abscesses from acquiring any great size, causing them to present under the form of tubercles, cured with facility, if opened before they have extended to the septa of the gland.

Proceeding from the substance of the gland to this point, pus frequently pursues a tortuous course, in consequence of the fibrous intersections conducting it. When it reaches the areola, the abscess may remain small, but not the less leave a fistulous opening, most difficult to cure, on account of its depth, and the mischief produced. Superiorly, it produces another kind of abscess, still more difficult of cure, on account of the opening being superior to its base. Below, the ulcer, being most depending, favours the issue of fluids. The obstacle opposed posteriorly to the pus, by the aponeurotic layer of the gland, forces it most commonly towards the skin, but occasionally the contrary occurs, and then, if surrounding adhesion has not been well established, diffused inflammation ensues, and the suppuration spreads over a large extent of surface.

Thus, the breast is subject to three variations of abscess:—Firstly, subcutaneous abscess, least serious of all, tubercular, near the nipple, and larger as they are more distant from the centre. Secondly, sub-mammary abscess, commonly very large, and with difficulty distinguished in the beginning. Thirdly, abscess commencing in the mamma or among its septa, frequently becoming subcutaneous, sometimes sub-mammary.

From these remarks we perceive, that the first cannot be opened too early; that the second must, in addition, be largely and deeply incised; and that, to cure the third, it may be indispensable that we carry the incision completely through the substance of the gland.

The breast, by its posterior surface, is, in some measure, continuous with the pleura, by means of its investing cellular sheath and inter-muscular cellular tissue. Thus, cancers of the breast frequently penetrate as far as the serous membrane of the thorax; and the inflammation and suppuration succeeding their removal, also, in some instances, produce inflammation of the pleura, hydro-thorax, &c.

CHAPTER SIXTH.

INTERIOR OF THE THORAX.

SECTION FIRST.

MEDIASTINUM.

Formed by the apposition of the two pleuræ, the *mediastinum* is a triangular space, obtuse towards the summit of the cavity which it divides. In front of the spine its two laminæ separate, so as to produce what some anatomists have termed the *posterior mediastinum.* Anteriorly, it divides in the same manner, to reach the posterior surface of the sterno-costal cartilages, and become continuous with the pleura costalis.

The *posterior mediastinum* encloses the aorta to the left, the vena azygos to the right, the œsophagus in the centre and in front; posteriorly, the thoracic duct; finally, cellular tissue, lymphatic glands, &c.

The *aorta,* which does not enter until after it has curved round the left bronchus, lies on the corresponding side of the vertebræ. It afterwards approaches the median line, becomes more anterior, and is, in relation,—firstly, in front and to the left side, with the pleura, or mediately with the root of the left lung; secondly, in front and to the right with the œsophagus and left pneumo-gastric nerve, which, being distant from it from half an inch to an inch, superiorly, approaches more closely to it as it descends, becoming attached inferiorly by dense cellular tissue. Posteriorly, it lies on the vertebræ, between the thoracic duct and great sympathetic nerve.

We perceive, from this arrangement, how its aneurismal tumours may compress the various organs, according to the point which they occupy below the arch. If superiorly, and the aneurism projects forwards, the left bronchus and pulmonary vessels would be pressed or flattened, producing difficulty in breathing, or interruption in the circulation. More inferiorly, the tumour compresses the œsophagus, pneumo-gastric nerves, and thoracic duct, if it is developed on the right; pushes against the heart, if it occurs to the left and in front; and if, posteriorly, it acts more particularly upon the vertebral column and splanchnic nerves. It is in consequence of this disposition, that its aneurisms occasionally burst into the bronchi, or œsophagus, into the pulmonary artery and pericardium; that rupture more frequently occurs in the thorax; that they disturb digestion and the course of the chyle, produce nervous symptoms, and destroy the bodies of the vertebræ, or ribs, to such an extent as to lead to the idea of abscess in the dorsal region.

Some tumours, which I saw, with Larrey, Royer, and Bouilland, appertained to aneurisms of this nature, and communicated with the aorta by means of a long morbid course, or species of aneurismal fistula.

The *posterior mediastinal*, *bronchial*, and *œsophageal arteries*, given off by the aorta, before it reaches the diaphragm, are not of sufficient volume to require much attention. The intercostals, anastomosing with the internal mammary, and the superior intercostal, from the subclavian, and with several branches of the axillary, form an uninterrupted chain from the neck to the pelvis, by uniting with the lumbar, epigastric, &c., and appearing capable of carrying on the circulation if the aorta be obliterated.

The *azygos* vein, receiving directly nearly the whole of the intercostal veins of the right side, where it lies, like the aorta, on the left, is also the rendezvous for most of those of this latter side, by means of the *semi-azygos*, which crosses the spine beneath the œsophagus. After it turns over the right bronchus, it ceases to belong to the posterior mediastinum. Uniting the two venæ cavæ, it may re-establish the venous circulation, if one of these large vessels should be obliterated, between their opening into the auricle and the points where they receive the extremities of the azygos. In the cases mentioned by Wrisberg and Huguier, this vein was double, and three or four large branches proceeded directly from the subclavian to the summit of the lung.

The *œsophagus*, covered by the trachea, in the same manner as in the neck, as far as the commencement of the bronchi, a little prolonged from the arteria innominata and superior vena cava, passes slightly to the right as it descends behind the trunk of the pulmonary artery, the origin of the aorta, the heart, and declining portion of the diaphragm, having, posteriorly and laterally, the right intercostal arteries and the aorta, the left intercostal and azygos veins, the thoracic duct, glands, &c., and, more remotely, the dorsal vertebræ.

Surrounded by the branches of the eighth pair of nerves, which form a plexus around it, before passing into the abdomen, it again inclines to the left, thus forming a prolonged curve in the chest, having its convexity towards the right, whilst in the sub-hyoid region we remark an opposite arrangement. This peculiarity should not be forgotten, in the introduction of instruments by the mouth into the stomach. It is almost needless to remark, that if the œsophagus becomes the seat of tumours, it may thus compress all the surrounding organs, and that its investing nervous plexus quite sufficiently explains the pain experienced, when it is distended by food or other matters.

The *thoracic duct*, placed behind the œsophagus, at first to the right of the median line, to which it approaches nearer as it ascends, terminates by passing to the left, opposite the fourth

dorsal vertebra. Enveloped in elastic cellular tissue, it adheres but slightly to the other organs, by which it may, nevertheless, be compressed against the spine, when they are enlarged by pathological alterations. With regard to its diseases, they are as yet but little known. However, Dupuytren and Sir A. Cooper have found it filled with tubercular, purulent, or cancerous matter. I have myself seen it, as it were, varicose, and of the size of my little finger. In four other instances, I found it filled with pus.

The *lymphatic glands* here, forming a kind of chain, are traversed by nearly all the absorbents of the abdomen, and receive those accompanying the intercostal vessels in the walls of the thorax; they, therefore, commonly swell, in diseases of the abdomen, and sides of the chest. If this swelling proceed to any extent, we perceive, that, in consequence of these relations, they would push the heart, aorta, and œsophagus either forward or to the sides; whence, anasarca, bad digestion, marasma, and difficulty of breathing.

The *cellular tissue*, always abundant in this situation, communicating above with the deep cellular tissue of the neck, allows the pus formed in the sub-hyoid region to descend along the spine into the chest, without flowing into the pleura. Continuous, in the same manner, with the abdominal cavity, through the aortic and œsophageal openings, it may also conduct fluids, and inflammation, behind the peritoneum. Many abscesses are thus formed by congestion.

Anterior mediastinum.—The pleuræ approximated in front of the œsophagus, from the diaphragm as far as the auricles of the heart, touch each other, superiorly, behind the organ of deglutition, because the aorta and vena azygos do not ascend above the third dorsal vertebra. Opposite the heart they separate to a considerable extent, to envelope that organ, and again approach each other before they proceed, externally, over the posterior surface of the sternum, where they limit the space termed anterior mediastinum. Notwithstanding Gavard has denied its existence, it is so evident, that all other anatomists have agreed upon the subject. We should be very guarded, however, in judging of its dimensions during life, from what we observe in the dead subject, after the sternum has been raised. If, to examine it, we remove the middle ribs, we perceive that the right pleura remains attached close to the median line; and that of the left side, although nearer to the margin of the bone inferiorly, does not quite abandon it; so that, to penetrate the thorax, without injuring the pleura, we must choose the median line superiorly, and the left side of the sternum below. In cases of abscess, we may act with less precaution, inasmuch as the pus tends to push the pleuræ on one side.

This space represents the letter X, or two triangles united by their apices opposite the heart. Its superior portion encloses

some lymphatic glands, a quantity of cellular tissue, the thymus gland, and internal mammary artery.* Tumours of any size, being unable to project externally across the sternum, ascend into the neck, press upon the trachea, sometimes resembling disease of the thyroid gland, or compress, posteriorly, either the arch of the aorta, or the large branches arising from it, and the superior cava.

In 1830, I saw a strong young man suffocated in this manner at the Hôpital de la Pitié. The tumour, which descended as far as the heart, had reached the larynx in the space of a month.

The second triangle, more prolonged, inclining to the left, descends as far as the eighth cartilage, and contains cellular tissue, some glands, and the front of the pericardium. MM. Riolan, Skielderup, and Laënnec, founded their theory upon this latter disposition, when they recommended opening this pouch, by trephining on the left side, and the inferior third of the sternum. By acting thus, we may avoid opening the pleura, whilst, by the methods recommended by Senac and Romero, we cannot reach the pericardium without cutting through two layers of that membrane.

Its *cellular tissue*, extending between the peritoneum and the muscles of the abdomen, behind the xyphoid cartilage, across the space separating the anterior digitation of the diaphragm, allows tumours, formed in the epigastrium, to mount into the neck, and abscesses of the sub-hyoid region to descend into the epigastric, with nearly the same facility as from the chest.

The inferior border of the mediastinum, lying on the diaphragm, presents, in front, the largest portion of the sub-sternal space; in the middle, a still larger separation, for lodging the pericardium; and, posteriorly, the pleura, touching in front of the œsophagus, and dividing immediately to form the posterior mediastinum.

The middle, or *proper mediastinum*, encloses, in its inferior half, the heart, with the superior and inferior vena cava.

The *heart* is so placed, that its apex beats against the fifth intercostal space, and the sixth rib of the left side, whilst, on the right, it does not pass beyond the sternum; consequently, penetrating wounds are much more dangerous in the former situation, and the right ventricle is most exposed, unless the instrument enters transversely. Some facts would lead us to imagine, that wounds of the heart, penetrating even its cavities, are not always fatal. One of the most remarkable is that published by Latour, of Orleans, of a man living six years after having received a ball in his chest, which was found, after death, lodged in the septum cordis. In 1818, assisted by M. Bretonneau, I passed needles through the hearts of several living dogs, and

* The internal mammary artery is not properly situated within this space, as it descends, externally to it, upon the cartilages of the ribs.

many of them did not appear to suffer the least inconvenience. I repeated the experiment in 1822, on a dog, which was very well six months afterwards. In 1825, an old man died at the Hôpital de la Faculté, who nine years previously had been stabbed in the left side of his chest. The pericardium was opened opposite the cicatrix in the thoracic wall; the heart presented a fibrous line, traversing the whole thickness of the right ventricle, at the point corresponding to the opening in the pericardium.

A true continuation of the central aponeurosis of the diaphragm, less dense and firm as it approaches the principal arteries than around the aorta and its branches, the vena cava, and bronchi, the *pericardium*, near the neck, becomes converted into lamellæ, analogous to those enveloping the trachea, œsophagus, and large vessels, thus becoming blended with the fascia cervicalis.

The inferior *vena cava* is here within the cavity of the pericardium, which it only leaves to traverse the diaphragm. Free between the œsophagus, heart, and lungs, it is thus protected against all compression, capable of completely effacing its calibre. Nevertheless, as it may be pushed out of its course by aneurisms, dilatation of the heart, enlargement of the right lung, and be thus curved so as to interrupt the venous circulation, I would ask, whether this may not be one of the causes of congestion of the liver, so common in these diseases, and in phthisis?

Above the heart, the *arch of the aorta* is separated from the first bone of the sternum only by cellular tissue; thus, its dilatation frequently produces abrasion and caries of this bone. Being crossed, on the left side, by the phrenic, pneumo-gastric nerves, and the recurrent hooking round it, to ascend to the sub-hyoid region, its aneurisms may give rise to aphonia, as imagined by the ancients; but it is also probable that this accident depends, more frequently, upon pressure upon the bronchi or trachea.

Without the pericardium, the arch of the aorta dilating would compress, in front, the thymus gland, cellular tissue, and the same parts as met with below; behind, the pulmonary artery, and termination of the trachea; more deeply, the œsophagus, lymphatic glands, and spine; on the left, the left bronchus, pulmonary artery, and veins, the vagas and phrenic nerves, and apex of the lung; finally, on the right, the superior vena cava, and the same nerves as on the left, but in a less direct manner. Its tumours may, consequently, disturb respiration, speech, the functions of digestion, and deglutition; interrupt the passage of arterial blood into the lungs, and the return of venous blood from them to the left auricle; derange the venous circulation of the upper part of the body, and the course of the chyle and lymph; and, finally, cause abrasion and absorption of the vertebræ and

sternum, or project across the intercostal spaces. These relations, also, explain how aneurisms may burst into the trachea or œsophagus, and also how foreign bodies introduced into these canals may tear the aorta.

The *pulmonary artery* divides within the pericardium. Running to the root of the lungs, its two branches describe a kind of lozenge, with the bronchi passing over their anterior surface, to enter between them and the pulmonary veins.

The *right pulmonary*, longer and larger than the preceding, covered by the aorta, superior cava, and vena azygos, lying on the right pulmonary veins, and rather higher on the œsophagus, afterwards, on the corresponding bronchus, is thus crossed by the phrenic nerve, between the vena cava and aorta, subsequently, by the cardiac plexus, separating it from the latter.

The left pulmonary, shorter and smaller, lies, at first, on the left auricle, and, more remotely, on the thoracic aorta. It is, next, placed in front of the bronchus. The lung conceals it in front, and the arch of the aorta turns over it, in embracing the root of the lung. The phrenic nerve is applied more immediately upon it than on the right side. It is, evident, from this arrangement, that, when these arteries become aneurismal, they may react in a distressing manner upon the aorta, the cava and pulmonary veins, the bronchi, phrenic nerves, &c.

The *pulmonary veins* are not of equal length. Those of the left side, scarcely an inch long, are placed immediately in front of the first bronchial divisions, running, at first, beneath the artery, and subsequently on its anterior surface, before they penetrate the lung. Those of the right side, covered by the trunk of the pulmonary artery, aorta, superior vena cava, terminate in the same manner as those on the left side.

The *superior vena cava* is thus anterior to all these parts, and very close to the sternum. To the right, and fronting it superiorly, the phrenic nerve passes over its lateral portion as it descends. The pneumo-gastric remains more superficial than the trachea, as far as the commencement of the bronchi; it then dips down, and runs behind the root of the lung. On the left these two nerves run over the corresponding surface of the aorta, and are thus on a posterior plane. The phrenic continues its course in front of the vessels, enters as on the right, between the lamellæ of the pericardium, so that in extensive dilatation of the heart it may be stretched, giving rise to pains in the neck, and other nervous symptoms.

In addition to the vessels and bronchi, which unite and interlace to form the respiratory organs, we find several lymphatic glands, swelling, and frequently becoming disorganized in phthisises, and in scrofulous persons, during rubeola, hooping cough, and several of the chronic inflammations of the mucous membrane of the bronchi. These glands may compress the pul-

monary veins and arteries, induce hæmatosis, press still more frequently on the bronchi, with which they contract adhesions, sometimes piercing them, and, if suppurating, discharging through these canals.

SECTION SECOND.

PLEURAL CAVITIES.

The left cavity of the thorax, smaller than the right, in consequence of the inclination of the mediastinum, and projection of the heart, is longer, because the diaphragm ascends less on this side than the other. On the right, the liver pushes up the diaphragm as high as the first false rib.

M. J. Cloquet has even demonstrated that, in excessive respiration, the diaphragm may ascend as far as the sixth true rib, and that the lung would not then be injured by an instrument introduced through either of the first five intercostal spaces, counting from below upwards. The lung, during inspiration, filling the cavity, is, on the contrary, always injured in penetrating wounds of the chest. In the former case, the instrument would traverse the pleura costalis, and that covering the diaphragm; then the diaphragm and peritoneum, before entering the abdomen, and injuring the stomach or spleen on the left side, and the liver on the right. In the latter, the lung would be wounded before the diaphragm. At the summit of its cavity, the lung is separated from the supra-clavicular region by cellular tissue and the pleura, from the axilla by the first rib, and the internal surface of the four following. Inferiorly, its internal margin is attached to the side of the spine by a kind of triangular ligament, analogous to those of the liver.

The *pleura* is sometimes invested by a kind of fatty appendices, which must not be mistaken for traces of ancient inflammation. Destined to facilitate the movements of the lung, this membrane is very intimately united to it in many cases. Under these circumstances the remarks which have just been made relative to the abasement and ascension of the lung are no longer applicable. The mechanism of these adhesions merits some attention. The costal and visceral layers of this membrane may unite through their whole extent, thus obliterating, the cavity separating them. They may also remain divided by pus at one point, whilst they are consolidated everywhere else. The collection then occupies sometimes the inferior, sometimes the upper part, at others the posterior region, and occasionally the interval between the lobes of the lung. Therefore, when we consider the operation for empyema necessary, we must not reckon either upon the weight of the fluid, or the depending

position of the thorax. The same thing may result from penetrating wounds. When effusion takes place before the adhesions are established, the liquid will generally collect in the sinuous cavities, dividing the diaphragm from the ribs, or in the deep fossa which we see on the side of the spine when the patient lies on his back. When the effusion consists of blood, we frequently remark a patch of ecchymosis or œdema, at the bottom of the dorsal and costal regions, produced by the porousness of the cellular tissue. When, on the contrary, the collection does not form until several days after the wound, the latter may correspond to the centre of the effusion.

Emphysema.—When a wound penetrates the pectoral cavity, and the lung is torn, if the division of the external parts corresponds exactly to that of the intercostal muscles, the air rushes out; if, on the contrary, the openings in the different wounded organs do not correspond, the air infiltrates into the cellular tissue, and emphysema is the result. This may become very serious, when it extends over the whole body. Estenove, Letre, and Larrey have each related extraordinary examples of this nature, and I have myself seen some which are scarcely less so. We can conceive that if the pleura and lung are lacerated independently of the skin, this action would be still more likely to occur. Thus, nothing is more common than this affection in fracture of the ribs. If the lungs are torn, and the walls of the thorax not wounded, there will be fistula and pneumothorax; supposing that there is no adherence between the two pleuræ.

In these diseases the pleura costalis sometimes acquires a considerable degree of thickness, and in two different manners; in one, layers of albumen are deposited and organized on its internal surface, and therefore when we operate for empyema, we should calculate upon the possibility of such an occurrence. In the other, which generally coincides with a disease external to the thorax, the sub-pleura cellular tissue becomes thickened, and is transformed into a homogeneous layer, a kind of barrier, opposed by nature to the progress of the disease. This also, in deep abscesses, pushes the pus towards the skin, and prevents their opening internally.

Injuries of the thorax.—Instruments may reach the heart, by traversing the chest, perpendicularly, to its axis, above the sixth rib.

Introduced a little to the left, through the fourth intercostal space, they would fall on the base of the right ventricle, or on the left auricle; to the right, wound the corresponding auricle or ventricle; through the third, reach the trunk of the aorta, or pulmonary artery, and the superior vena cava on the right side; and through the second, divide the arch of the aorta, or the principal vessels arising from it. If we would touch the apex

of the heart, it is quite sufficient for the instrument to penetrate an inch and a half through the fifth space, at the union of the sternal and costal regions.

In the sixth intercostal space, a knife following the transverse diameter of the chest, introduced at about two inches in front of the latissimus dorsi, behind the pectoralis major, and above the two last digitations of the serratus magnus, would be situated immediately beneath the lung, traverse the diaphragm and liver, graze the inferior surface of the cordiforme tendon, again traverse the diaphragm, enter the pericardium close to the apex of the heart, arrive in the opposite pectoral cavity, pierce the lung of that side at some lines above its inferior border, and transfix at its exit the same parts as at its entrance. Through the seventh, the pericardium is not touched; in the abdomen the liver alone is wounded. The knife would then pass in front of the vena cava and cardiac extremity of the stomach, behind the hepatic vessels and the gall bladder; the spleen is not injured.

Through the eighth the knife remains, beneath the lobulus Spigelii, between the vena cava and vena porta, traverses the superior extremity of the stomach, and anterior border of the spleen, avoiding the left lobe of the liver.

Through the ninth, it passes beneath the gall bladder, traverses the vena cava or aorta, above the pylorus, the great cul-de-sac of the stomach, and the spleen.

Through the tenth, the right lobe of the liver is wounded, but at some lines above its border; the right kidney and the pylorus may be injured, and the stomach traversed at two points. The spleen commonly remains behind, and the pancreas itself is transfixed.

Lastly, through the eleventh, we wound the kidney in its upper third, and we may also injure the first portion of the duodenum, the pancreas, the left portion of the duodenum, and the commencement of the descending colon. If the instrument is directed from the costal cartilages backwards, towards the median region, it would come upon the bodies of the vertebræ, and might hurt the great sympathetic nerve, or the aorta. It should be observed, that these injuries are susceptible of great variation, in consequence of the separation of the ribs, changing the absolute length of the costal wall, and the pectoral cavity. Thus, during any violent effort, as in hydro-thorax, all the intercostal spaces are enlarged. In ascites, and among new-born children, &c., where we remark a contrary arrangement, similar external injuries would cause different internal affections.

Diseases also affect the relative positions of the organs, which is especially evident, as regards the form of the chest, and the motions of the ribs. For example, in hydro-thorax of one side only, if the disease is very far advanced, this side appears longer,

and more prominent than the other. When the effusion disappears, (if the patient be cured,) the lung, having been long pressed upon by the fluid, does not re-assume its proper size; the thoracic wall recedes, and the chest thus shrinks at the affected side. This continues through life, and I have seen curvature of the spine thus produced. In pleurisy, particularly acute pleurisy, whether or not there be effusion, the pain preventing the muscles from contracting, causes the ribs to remain immoveable, on the side corresponding to the disease; whilst, on the other, the movements of inspiration and expiration are much augmented. Finally, if the lung be hepatised, if there be peripneumonia, accompanied or not by costal pleurisy, the same result might still ensue. Particularly, as in this case, the essential organ of respiration becomes considerably enlarged, it may be said, that the cavity is then too small to contain it. The ribs, resisting more than the soft parts separating them, are closely applied upon the external face of the inflamed lung, and produce grooves more or less distinct. The latter peculiarity, mentioned by M. Broussais, and disbelieved by Laënnec, I have frequently witnessed.

The thoracic walls vary in thickness, with situation, age, and individuals. In children, being proportionably thinner, in consequence of the absence of fat, and the smallness of the muscles, they are more sonorous than after puberty; therefore, if we were to judge of the diseases of the chest in youth, by sound alone, we should think the lungs still permeable, although there were complete hepatisation. Thin on the median line, or where the sternum is only covered by the skin, thin also on the sides, in the inferior half of all the sternal region, where the cartilages are separated from the integuments by the rectus abdominis muscles, they are generally very thick, laterally, on their superior half, on account of the mamma and great pectoral muscle. In the posterior region, they are extremely thick in the median line, and even as far as the angle of the ribs, in consequence of the vertebral column, and the mass of muscles, filling the posterior fossæ. Externally and superiorly, the shoulder renders them thicker than elsewhere, but beneath the axilla, and in all the costal region, they are as thin as at the base of the sternal region. These facts, important relative to wounds of the chest, are equally so, in percussion of this cavity, or in the application of the stethoscope. We should, also, recollect the precise relation of the viscera to the different regions of the external surface. Thus, notwithstanding the spongy texture of the sternum, and the thinness of the soft parts beneath the breast, in the sternal region, the chest is not very sonorous, at least in the left side, because these points correspond to the heart, and principal blood-vessels. Thus, osculation should here come to the aid of percussion, for which the clavicle, never being covered by thick soft parts, and corre-

sponding to the summit of the lungs, is one of the most advantageous points. The posterior region, by its lateral convexities, which being covered by very thin muscles. receive, internally, the most spongy portion of the lung, offers nearly the same advantages for percussion or oscultation. I shall say but little of the sides, excepting that the liver considerably diminishes the sound at the base of the right region, whilst, on the left, the stomach pushing against the diaphragm, augments it in the same proportion. These circumstances may lead us to imagine, in the one instance, that the lung is impervious when healthy, and in the other, that this organ is healthy, when it is more or less disorganized.

SECTION THIRD.

INFERIOR REGION.

The *diaphragmatic* wall, or region of the chest, the most moveable and variable, formed entirely by the superior surface of the diaphragm, is strongly elevated during expiration, descending when the air distends the lungs. In the former case, two rounded eminences mount into the thoracic cavities, rather more marked on the right than on the left. Physiologists, who considered that the respiratory organ dilated and contracted in a passive manner, contended that the air was forced out by the contraction of the diaphragm. But they here mistook effect for cause, the muscle merely following the lungs in the same proportion as the air is forced out by their proper action. In the latter, it really contracts, although it may also descend mechanically. In this action, its fibres push the abdominal viscera downwards, forwards, and slightly to the right, being so inclined as, in some degree, to loop in this direction. It is, also, to this slight inclination of the diaphragm that we may, to a certain extent, attribute the greater frequency of herniæ on the right side. During action, it draws upon the ribs to which it is attached, contracting the circle which they form, and keeping them more or less firmly fixed; thus affording a solid point of attachment, either directly or indirectly to all the other muscles of the trunk. At the same time that the glottis becomes hermetically closed, the lungs, distended by air, exactly fill the interior of the chest, maintaining the walls properly separated.

We thus explain why the violent efforts occur only during inspiration, and why they prevent speaking, singing, and laughing. I must, however, remark, that an opening in the larynx or trachea, which, according to this theory, should considerably weaken the muscular action of the individual, is far from constantly producing this effect. The various operations for bron-

chotomy, performed by Bretonneau, myself, and others, fully bear out this assertion.

The phrenic nerve coming from the cervical plexus, a wound in theneck may paralyse the diaphragm, and, for the same reason, certain diseases of this muscle are referred to the supraclavicular region and shoulder, as in inflammation of the convex surface of the liver.

SECTION FOURTH.

SUPERIOR REGION, OR SUMMIT OF THE CHEST.

The *superior opening of the chest* is of the form of an ellipse, having its posterior wall pushed considerably forwards. Constituted, anteriorly, by the supra-sternal notch; posteriorly, by the bodies of the seventh cervical and first dorsal vertebræ; externally, by the concave margin of the first rib; this opening is not on a plane, either even or horizontal. As it is raised posteriorly, several organs, placed deeply in this latter direction, are already in the thorax, whilst, more superficially, they would still be in the sub-hyoid region. External to the median line, the sterno-clavicular articulation increases its elevation, thus affording greater protection to the important organs behind it. Laterally, it again becomes lower, in consequence of the inclination outwards of the upper surface of the rib.

The *summit of the chest* encloses, from right to left, and from before backwards, the superior vena cava, which receives the subclavian*, the right internal mammary artery, the innominata, anterior and external to which, are the pneumo-gastric and phrenic nerves; finally, the root of the carotid and subclavian arteries of the left tide.

The *innominata* or *brachio-cephalic* artery is here an important organ. About an inch and a half in length, it ascends, inclining slightly to the right, as far as the sterno-clavicular articulation, where it divides, covered from the deep-seated parts, to the skin, by the right pneumo-gastric and cardiac nerves, the termination of the internal jugular, subclavian, thyroid, and superior cava veins, the origin of the sterno-thyroid and hyoid muscles, the sternum, the head of the clavicle, and the internal tendon of the sterno-mastoid muscle. It is prolonged from the trachea by some lymphatic glands and cellular tissue. To the right it approaches very closely to the pleura.

To expose the trunk of the innominata, we should depress the right shoulder, at the same time that the head is thrown backwards, and to the left side. We must next divide the sternal tendon of the sterno-mastoid muscle, separate some veins which descend behind this muscle, cut across the sterno-hyoid and

* Vena innominata.

thyroid muscles, tear through a thick and strong fibrous lamella, depress the left subclavian vein, pushing the jugular, the right vagas, and phrenic nerves towards the summit of the right lung, and pass the ligature round it, directing the needle from before backwards, and from the right to the left side. This is one of the most difficult and dangerous operations in surgery. A priori, it is almost frightful to think of, inasmuch as the circulation through the right superior extremity would appear to be completely cut off; but experience has shewn that the circulation is not so completely destroyed, as would at first appear. In fact, the artery has been tied three times; once by Mott, at New York; by Graeffe, in Germany; and by Bland, in England. Although unsuccessful, these attempts prove that life may be preserved in the limb, and other parts, supplied by this artery. In the first case, the patient did not die until the twenty-sixth day; in the second, he lived two months; in the third, the patient operated on, upon the 25th March 1832, did not die until the 13th April. An incision parallel to the border of the left sterno-mastoid muscle, as recommended by O'Connel and King, rather more obliquely, or even quite straight, in the supra-sternal fossa, would admit of attaining and isolating the vessel, without cutting through any muscle.

In a diseased condition, the innominata, supported by the sternum, speedily compresses the trachea, and even the œsophagus posteriorly, the cava and subclavian vein anteriorly, pneumogastric to the right, and the carotid artery to the left. Its tumours may extend into the supra-clavicular or sub-hyoid region, assimilating to aneurism of the common carotid artery. Burns has related a remarkable case of this nature, and we can imagine that the mistake might be attended with a great deal of danger, if we attempted to reach the artery beneath the disease. In a case cited by Rivière, the tumour extended beneath the clavicle to the bottom of the axilla. The anomalies of the innominata have been described in the *supra-clavicular* and *sub-hyoid regions.*

The left carotid offers, at the upper part of the mediastinum, the same relation as at the base of the neck. Anteriorly, it is covered by the thymus gland in the infant; in the adult, by loose cellular tissue, lymphatic glands, subclavian veins, left sterno-hyoid and thyroid muscles, sternum, and sterno-clavicular articulation.

Posteriorly, it is prolonged from the vertebræ by the longus-colli muscle, pleura, and cellular tissue. Finally, on the left side, the pneumo-gastric nerve accompanies it, and the pleura separates it from the lung, as far as the first rib. Being thus much more deeply seated than the trunk of the innominata, and nearly uncovered, at the summit of the thorax, great caution is required in applying a ligature upon it, previous to its passing the first rib.

We also find, at this portion of the chest, *first*, the origin of the sterno-hyoid and thyroid muscles, which descend to the first intercostal space, behind the sternal notch and sterno-clavicular articulation: *secondly*, a thin, tolerably dense, cellular layer; on the same plane, to the left, the subclavian, and termination of the internal and external jugular veins; in the middle, the subclavian again, and the termination of the thyroid veins and thymus gland; to the right, the union between the right and left subclavian, internal and external jugular, to form the superior vena cava: *thirdly*, very tense fibro-cellular tissue, separating the veins and arteries behind this layer, from right to left, the termination of the arteria innominata, the origin of the primitive carotid and subclavian arteries, very close to the bones, the internal mammary, proceeding to the posterior surface of the sternum, accompanied by its two veins; the middle thyroid artery, when it exists; the vertebral, when it arises from the aorta; the left carotid; more deeply, the subclavian, giving off the internal mammary of this side; the phrenic and vagas nerves, placed on the right side, in front, and a little external to the arteria innominata, and on the left in front and some distance from the subclavian artery: *fourthly*, the trachea, enveloped in dense, firm, fibro-cellular tissue, externally, some lymphatic glands, the recurrent nerves: *fifthly*, the œsophagus in the middle, extending slightly beyond the trachea on the left side; the origin of the vertebral, superior intercostal, and transverse cervical arteries, with their collateral veins: *sixthly*, the longi-colli and anterior scaleni muscles, leaving between them a triangular space, with its base directed downwards, in which, beside the vertebral artery and vein, a plexus furnished by the great sympathetic nerve; under the head of the rib, the inferior cervical ganglion: *seventhly*, the bodies of the vertebræ, less prominent, but rather more extended transversely than anteriorly, the first costo-vertebral articulation; sometimes a costiform prolongation surmounting the transverse process of the seventh cervical vertebra, the first rib and anterior branch of the first dorsal nerve, proceeding to unite with the last cervical.

From this enumeration, it is easy to foresee the danger of wounds at the summit of the chest, and how effusions, or accumulation of fluids in the middle and lateral regions of the neck, may spread behind the sternum, in front of the spine, or follow the vessels into the anterior and posterior mediastinum, without penetrating the pleural cavities. We may, also, understand the accidents which may ensue from exostosis, produced by syphilis on the anterior of the vertebræ, or, more frequently, in the clavicle and sternum; luxations of the clavicle backwards, by its pressing upon the trachea, œsophagus, veins, arteries, and nerves.

A large cyst adhering to the summit of the lungs, or deeply developed on the external surface of the pleura costalis, may

project, rising more or less, on the side of the neck, and be mistaken for aneurism of the carotid, or a sacciform tumour of the thyroid gland, of which I saw a beautiful example in a woman, whom M. Reyer begged me to examine. The cyst was filled with very thin blackish matter.

Described by Sir A. Cooper as the *thoracic fascia*, the *aponeurosis*, as I have already pointed out in this work, is not, as he considers, a distinct fascia. Rather stronger, more evidently fibrous over the sides, between the sterno-thyroid and deep parts, it is continuous with the fascia of the axilla and the layers of the neck, before terminating on the vena cava, the trunk of the innominata, which it sustains and strengthens.

The *thymus* extends, from the arch of the aorta, as far as the supra-sternal fossa. Prolonged by elastic cellular tissue, between the sterno-hyoid muscles, in front of the trachea, it thus attains the sub-thyroid space, forming the means of communication between the sub-hyoid region and mediastinum. Though rarely, it may become altered by disease; Cooper cites an example. The tumour projecting above the sternum assimilated aneurism, and the young girl died very speedily from suffocation. Arrested by the sternum in front, spreading with difficulty over the sides, in quitting the chest, in consequence of the resistance of the fascia, the thymus, or any other tumour in the same situation, cannot increase in size, without pressing upon the aorta and its principal branches inferiorly, the trachea and left subclavian veins superiorly, whence almost inevitable death.

I would subjoin, that the diminished strength of the aponeurosis behind the sternal notch, and in the posterior half of the pectoral opening, gives it the form of a triangle, having its base external and anterior, or reduces it to a species of band in its middle portion, between the sterno-hyoid muscle and trachea. It is also, posteriorly, on the sides and front of the median line, that diseases show themselves most frequently when they emerge to the neck from the chest, or reciprocally.

SECTION FIFTH.

WALLS OF THE THORAX.

Divested of its viscera, the *thorax* presents *four walls* internally, as externally. Its *anterior*, forming a curve, the concavity looking downwards and backwards, is enlarged more than the rest, towards puberty, the sternum being rapidly developed at that age. Its *posterior* is much longer, and more so in proportion during infancy than in after-life. The vertebral column, very long at birth, and the sternum, on the contrary, very short, causes the abdomen to appear very large in front, whilst, posteriorly, it bears much the same proportion to the chest as it will subsequently possess. This wall, concave, and not simply inclined

backwards, is constituted, *firstly*, by the bodies of the dorsal vertebræ, forming a species of smooth crest, which, in reality, represents the back of the posterior mediastinum; *secondly*, by the curved portion of the ribs, forming, laterally, the two cavities which principally receive the lungs. In very young children, the bodies of the vertebræ appear thrown backwards, on account of the angle of the ribs not being as yet formed. In such cases, the lungs, less free, and constrained in their functions, are more liable to chronic diseases; the chest appears contracted; the shoulders project posteriorly, and the sternum in front. The heart beats more freely, in consequence of the enlargement of the antero-posterior diameters of the cavity.

The *lateral* wall of the thorax, longer posteriorly than in any of the others, concave transversely, is likewise so in many individuals, from above downwards; particularly among females who lace tightly.

The difference of curvature and length, in the thoracic walls, causes the base and summit of this cavity to incline inversely. As its superior opening declines, whilst the inferior ascends, a line carried, perpendicularly, through the centre of the former would fall upon the base of the dorsal column, instead of which, through the centre of the second, it would terminate on the body of the first dorsal vertebra. The vertical axis of the chest is, therefore, oblique from above downwards, behind forwards, and from the left to the right side, in consequence of the lateral curvature in the middle of the dorsal spine. As to the transverse dimensions, they augment gradually as far as the seventh rib. Continuing to descend, they still enlarge, but slightly. In some individuals, they remain as they were, higher up. Sometimes they decrease in a very remarkable manner.

The pleura being invested by cellular tissue, denser opposite the ribs, and more elastic in the intervals, is thus continuous with the subcutaneous layer. It is, therefore, not unfrequently perforated at points corresponding to cavities in the lungs, in phthisis, allowing the pus to spread beneath the skin. The communication of these abscesses with the respiratory organ has given them a peculiar character; it is there that air becomes diffused, producing crepitation. Whence they may be distinguished from abscesses emanating from the pleural cavity, or mediastinum.

The *internal thoracic fascia*, or external cellular tissue of the pleura, being continuous, anteriorly, and posteriorly, with that of the mediastina, superiorly with the side of the neck, inferiorly with the trunk, and being nowhere so abundant or elastic, explains why the pus, there generated, extends so far before collecting into abscess. The pressure of a regular membrane, continually pushed outwards by the lungs, accounts, in its turn, for the tendency of these deposits to point externally, rather than to open in the thoracic cavity.

CHAPTER SEVENTH.

OF THE ABDOMEN.

Limited, superiorly, by the chest, inferiorly by the pelvis, the *abdomen* encloses nearly all the organs of digestion. Among adults, it is larger inferiorly than superiorly, especially in females, where this distinction depends on the greater developement of the pelvis, and the contraction of the thorax by stays. In infancy, there is an inverse arrangement. The pelvis, being at that period very narrow, the sternum short, and the ribs more or less elevated, the abdomen appears much larger superiorly. Its larger dimensions, anteriorly than posteriorly, result, on the one hand, from the pelvis and thorax slanting considerably in the anterior third of their circumference, and on the other, from their planes inclining in opposite directions, whilst, posteriorly, they, on the contrary, approximate.

As the diaphragm allows the viscera to ascend considerably, posteriorly, the abdominal cavity may be pretty correctly defined on the exterior, by a circular line, terminating by its two extremities, one on the base of the xyphoid cartilage, and the other on the spine of the tenth dorsal vertebra.

Remarkable in regard to its varieties in size, and the points presenting most marked eminences, the abdomen is very large in the fœtus, where it projects particularly upwards, and to the right side, in consequence of the preponderance of liver. In infancy it is also very large, on account of the chest and pelvis not being completely developed until after puberty. Women, in general, have larger abdomens than men, especially those who have borne several children. Up to the adult period of life, its size is commonly in relation with that of the digestive organs. Later, on the contrary, it mostly depends upon the quantity of fat accumulated in the subcutaneous tissue or omenta.

SECTION FIRST.

PARIETES IN GENERAL.

This division of the trunk contains a mobile extensible portion composed of soft tissues, and another enclosing the skeleton. The former constitutes the proper wall of the abdomen. Of much greater importance in surgery than the latter, it merits a considerable attention in some of its regions. When separated from the body and flattened, it is lozenge-shaped. Its lateral angles are prolonged backwards, between the crest of the ilium and the ribs, towards the vertebral column. Superiorly, it is

attached to the cartilages of the false ribs and the xyphoid appendix. Inferiorly, it is fixed to the whole length of the crest of the ilium, or Poupart's ligament. In the thin muscular adult we see on its exterior, firstly, superiorly, in the median line, an excavation, terminating the centre groove of the sternal region, and constituting the *epigastric depression* *, or vulgarly, the *pit of the stomach;* secondly, more inferiorly, a groove, in general superficial, extending from the preceding to the pubes; thirdly, close to the pubes, an eminence, termed *mons veneris;* fourthly, external to the median line, two prominences, corresponding to the recti muscles, parallel to the axis of the body, and intersected by transverse depressions; fifthly, more laterally, two large depressions, at first superficial, and gradually becoming deeper as they approach the spine.

The *skin* is generally very thin. The subcutaneous layer, composed of numerous lamellæ, enclose the ramifications of the capillary arteries and several branches of the lumbar, external iliac, intercostal, internal mammary, &c., arteries and veins, some nervous filaments, and adipose vesicles. Its deep layer constitutes the *superficial fascia.* I have elsewhere remarked that this fascia is not peculiar to the abdomen, as we find an analogous membrane beneath the skin of the other parts of the body.

In young or fat persons, this is scarcely distinguishable as an aponeurosis, whilst in thin and old individuals it is thick and easily separated. It is continuous with the subcutaneous cellular tissue of the thorax, the circumference of the pelvis and of the inferior extremities.

On the abdomen, the *fascia superficialis* appears to originate at the median line by numerous dense, compact, and slightly elastic filaments, which appear derived from the aponeurosis, to attach themselves, on the one hand, to the skin, on the other, to form a simple cellular membrane over the sides. In consequence of its regularity, inflammations of its deep layer are almost always diffused; ecchymosis extends with astonishing rapidity; and fluids spread in all directions from the median line, where it adheres more intimately.

Muscles.—The *pyramidales*, arising from the pubes, are prolonged by a small cord as far as the umbilicus. The *recti*, enclosed in a very strong fibrous sheath, descend from the thorax to the pubes, serving to maintain the thorax and front of the pelvis in proper relation. The *obliquus externus* extends downwards and inwards, from the seven last ribs to the crest of the ilium. The *obliquus internus* ascends from the crest of the ilium and Poupart's ligament to the margins of the cartilages of the false ribs. The *transversales*, arising from the summit of the spinous, and from the base and apices of the transverse processes of the lumbar vertebræ, by three fibrous laminæ, terminate at

* Scrobiculus cordis.

the external border of the abdominal aponeurosis, and are attached to the internal surface of the cartilages of all the false ribs, where their digitations interlace with those of the diaphragm. We must remark that the oblique and transverse muscles form three regular super-imposed layers, separated from each other merely by thin cellular tissue. The fibres of the most superficial are directed downwards and inwards, those of the middle obliquely backwards and downwards, and the internal transversely; thus offering a much greater resistance than if they were parallel.

The *aponeurosis*, strong and very complex, receives or gives off, by its external border, the large muscles just mentioned. The obliqnus externus furnishes its first layer, the principal fibres following the direction of the muscle. This membrane, attached to Poupart's ligament, proceeds, singly, to the margin of the rectus muscle. There it unites with a layer of the internal oblique, the aponeurosis of which also, at first single, becomes doubled in arriving at this spot, its anterior portion immediately uniting to the posterior surface of the preceding, passing with it in front of the rectus, to become attached to the linea alba. The posterior layer of the internal oblique is soon lost in the aponeuroses of the transversalis, which is very strong, and, thus augmented, runs behind the rectus to rejoin the anterior layer at the linea alba. This arrangement does not, however, exist through the whole extent of the abdominal parietes, as the aponeurosis of the transverse ceases to be distinct at the inferior fifth of the posterior surface of the rectus, which is then only separated from the peritoneum by cellular tissue, or fascia propria.

In fine, the dense fascia of the abdomen is formed by three layers. The middle aponeurosis, derived from the internal oblique dividing into two layers, uniting with those of the external oblique anteriorly, and transversalis posteriorly, has but two folds to envelope the rectus muscle, internal to which they again unite, becoming blended one with the other.

This line, consequently, forms a species of cord or tendon, extending from the xyphoid appendix to the symphysis pubis, and which may be considered as a centre, whence all the fibrous elements of the abdomen emanate. Continuous, superiorly, with the aponeurotic layers, between which the sternum is situated, it terminates, inferiorly, in the fibrous tissue in front of the pelvis.

Destined as a substitute for the skeleton in the median line, comprehending all the fibrous portion, separating the recti muscles, instead of being a distinct band, the linea alba varies in length and thickness, through the whole of its course. However elastic and firm it may be considered, it is by no means analogous to the yellow ligaments to which it has been compared, unless in large quadrupeds, where the weight of the super-

imposed viscera renders such a modification indispensable. Very tense between its two principal points of insertion, it serves to limit their separation, so that its transverse section would not be without danger. Its fibres, almost always parallel to the axis of the body, fray and separate in persons having large bellies, such as pregnant women, and individuals labouring under ascites, occasionally allowing the viscera to protrude and form true hernia; the peculiar character of which is, that they do not become strangulated, because the sac is generally funnel-shaped, larger at its orifice than at its termination.

The linea alba is not the only part which is altered in enlargement of the abdomen. All the aponeuroses become thinner. The several small openings, with which they are naturally pierced, enlarge, thus favouring the formation of herniæ. The recti muscles separate from each other, flatten, and at the same time drag the epigastric artery outwards; this must be remembered in the operation of paracentesis abdominis. This stretching of the abdomen gives rise to many other inconveniences, such as pain in the kidneys, bearing down, pain in the hypogastric region, sometimes mistaken for disease of the uterus, and too frequently neglected. The bandage after paracentesis is applied to prevent these consequences, and it is for the same reason that the abdomens of lying-in women so frequently require support, not only at the time, but subsequently; more especially where they are fat, or very tall.

Those portions of the aponeurosis which have been stretched, always remain the weakest. Here the large muscles on the sides, and the recti muscles in front, strengthen the others, by resuming their natural situation. Thus, herniæ, principally, occur at the umbilicus and linea alba above it, near the ribs, and above the groin.

Arteries, veins, and lymphatics.—The first are the *epigastric* and *circumflexa ilii* arteries, rising from the external iliac; the lumbar branches, the termination of some of the intercostals and internal mammary, which have already been enumerated in treating of the subcutaneous layer. The veins accompany the arteries, and the lymphatics divide into those above and those beneath the umbilicus.

The *nerves* are almost all derived from the lumbar plexus. Some branches from the intercostals must also be enumerated. Descending obliquely, from behind forwards, their origin is much higher than appears at first. Thus, injury of the spinal marrow may occur in any part of the lumbar region, without paralyzing the abdominal parietes; but should this occur, blisters, moxas, &c. must be applied as high as the ninth dorsal vertebra. The various points of the abdomen present such different characters, that anatomists have long since divided them into different regions.

SECTION SECOND.

REGIONS.

Thoracico-gastric region.—The upper part of the abdomen comprehends the epigastric and hypochondriac regions. Its vertical dimensions are much larger in front than behind, the circle limiting it inferiorly being much nearer the supra-epigastric line, as it follows the inferior border of the last rib.

Epigastric region.—Circumscribed by the lower extremity of the sternum and the cartilaginous border of the first false rib, the *epigastric* is triangular, having its base directed forwards. Externally, it presents, in the median line, a *depression* surmounted by a projection, corresponding to the cartilage of the sternum, and, laterally, the arch formed by the cartilages of the ribs. The recti muscles are rarely very prominent. As the apex of the heart is very near, and its palpitations may be always felt, the *epigastrium*, or *pit of the stomach*, is also known as the *scrobiculus cordis*.

The *skin* has no very marked peculiarities; it is delicate and light-coloured. In adult man it is frequently covered by hair. Its sebaceous follicles are rather numerous. Its sensibility, naturally very acute, is so much so in some individuals, that it may be mistaken for disease of the subjacent organs. Although its circulation has but little connexion with that of the stomach, the applications of cupping glasses, leeches, counter-irritants, here, is attended with great benefit.

The *subcutaneous layer*, thin and simply cellular in children, thickens with age. This, equally adhering to the skin and aponeurosis, is continuous with the cellulo-adipose layer of the sternal region, containing neither vessels nor nerves of importance. It may be the seat of chronic or acute abscesses, having a great tendency to spread, but seldom pointing towards the cavity of the abdomen, on account of the strong resistance offered by the muscles and aponeurosis.

Aponeurosis.—The expansion of the obliquus externus is united to the transversalis merely at the linea alba. Its fibres are so disposed as to form a perfect membrane, having but few vascular openings, through which the fat seldom protrudes. The aponeurosis of the internal oblique offers no peculiarity, excepting that it enters but little into this region, whilst the transversalis supplies a small quantity, triangular, and concealed by the recti muscles. The fleshy fibres, giving off the latter, arising from the costal cartilages, and being closer to the median line at the upper part of this region, it can only be seen near the linea alba, excepting quite inferiorly, where it is met with external to the rectus. Its fibres, evidently interlaced, make it appear that

those of the aponeurosis, of one side, cross the linea alba to mingle with those of the other; thus, in some measure, preventing the linea alba from unravelling here, although it is not so strong.

The epigastrium rarely participates in the general distension of the abdomen, unless during the last month of pregnancy, or in extreme cases of ascites. It yields on one side of the median line more frequently than on the line itself, inasmuch as the expansion of the external oblique, being here unassisted, offers but little resistance. These separations leading to epigastric herniæ, it is not surprising that the stomach should occasionally be implicated, as advanced by Garangeot and others; attentive observation can scarcely leave any doubt upon the subject. When herniæ occur at the lower part of this region, they commonly contain a portion of the transverse colon, which may become strangulated, or, at least, produce serious inconvenience.

Between the peritoneum and the muscles, between the former and the aponeurosis, and between the two layers of the latter, there are cellular tissue, and fatty processes. These latter may traverse one of the openings in the aponeurosis, increase in all directions, rise under the skin, forming a hernia, containing fat implicating the peritoneum, and subsequently portions of the viscera, giving rise to a train of very alarming symptoms. The thinness and disposition of the fascia at the summit of the epigastrium, near to the median line, render these the common situations of these accidents; but I have also met with them external to the rectus muscle, where the fibrous lamellæ also present openings for the passage of blood vessels.

Muscles.—We find in this region merely the upper portion of the rectus muscle. Broad and thin, it here commonly presents its two superior intersections, which unite it firmly to its anterior sheath, whilst it adheres only by cellular tissue to the other. The transversalis here, as lower down, appears to be only a prolongation of the diaphragm, folded upon itself, to become attached to the tendinous cord of the median line by its terminating aponeurosis. The fibres are nearly all the same length, that is to say, from one to two inches. The most superior proceed from the cartilages of the ribs almost to the median line, without giving off any aponeurosis. The inferior terminate, on the contrary, external to the rectus muscle, in the fibrous membrane, entering into the formation of the sheath of the latter.

Arteries.—The internal branch of the internal mammary, and some from the intercostal, are the only ones met with. The first, after having traversed the attachments of the diaphragm, sends a branch inwards, between the cartilage of the seventh rib and the xyphoid appendix, to anastomose with a similar branch from the opposite side, in front of the cartilage, where it is subcutaneous. As it is occasionally rather large, even super-

ficial wounds may be succeeded by hemorrhage. This offers an objection to M. Larrey's method of operating at this point for dropsy of the pericardium. The other branch, also large, descends, perpendicularly, between the muscular fibres on the external side of the rectus muscle, terminating by ramifying in the subcutaneous tissue.

All the branches of the intercostals are similarly distributed, excepting that their direction is more oblique. Situated, at first, between the transverse muscles and other layers of the region, they subsequently traverse the latter to anastomose with the branches of the internal mammary. Finally, these arteries are too small to be of any consequence in wounds or diseases of the epigastric veins. The internal mammary, epigastric, and even the intercostal, are double, and so large that, without reckoning the subcutaneous, the venous system is richer than the arterial. They, however, only become varicose in the last stage of pregnancy, or when the abdomen has been long distended, from any particular cause, or where a large trunk has been obliterated, as in a patient whose case I have published.

The superficial lymphatics pass into the cavity of the axilla, whilst the deep proceed to the glands of the anterior mediastinum. Therefore, we frequently see the axillary glands swollen, in acute or chronic inflammation, suppuration, or other diseases of the superficial layer of the epigastrium. Blisters, for example, often produce this mischief.

Intermuscular suppurations, on the contrary, cause lesion of the glands in the interior of the thorax.

What few *nerves* there are, belong to the intercostal, and are unimportant.

Between the rectus muscle and the anterior portion of its sheath, the *cellular tissue* forms a thin and lamellous layer. Posteriorly, we meet with a corresponding layer, but thicker, particularly in the centre, near the xyphoid appendix, where there is scarcely any aponeurosis. Extensible and elastic, this is continuous with the substernal cellular tissue. It thickens in descending, and fluids coming from the thorax or neck to the epigastrium are liable to accumulate here, instead of continuing their descent. We may hence conceive that an abscess may form between the peritoneum and the posterior layer of the aponeurosis, between the latter and the rectus, or rather in front of that muscle, especially external to the median line; whilst, if it forms in the external layer, the tumour may point as readily on the median line as laterally. Therefore, to determine that an abscess be seated in the subcutaneous tissue, it will be sufficient to ascertain whether the fluid be accumulated in front of the linea alba.

The epigastrium is naturally convex, projecting when the diaphragm descends, or when the stomach is filled; also in coughing, yawning, &c. On the contrary, in expiration,

vomiting, and after digestion, it presents a depression, allowing the liver to be felt on the right, and the pulsation of the cœliac artery, or aorta, on the median line.

The relation which this region bears to the organs corresponding to it posteriorly, together with the danger attending its wounds, shall be studied with the interior of the abdomen. We will only observe, that its wounds, however superficial, are with difficulty united by first intention. The costal eminences oppose the application of bandages, and the skin in the thorax is not sufficiently mobile to bear much stretching. Finally, the solidity of the hypochondrium does not admit of circular pressure contracting this region, as in the middle of the abdomen.

Hypochondrium.—Comprehending that portion of the abdomen corresponding to the bodies of the last true and five false ribs, this region enters entirely into the dorsal, sternal, or costal regions of the thorax. We shall reserve its description until we examine the abdominal cavity, and its viscera.

Meso-gastric division.—The middle circle comprises three regions; the *umbilical*, and two lumbar.

Umbilical region.—Circumscribed by the epigastrium, hypogastrium, and the two lumbar, this region, prominent in children and in some adults, is much more depressed as age advances or fat increases. Its centre is generally five inches distant from the anterior spinous processes of the ilium, six from the summit of the last rib, five and a half from the eleventh, five from the tenth or eighth, and four and three quarters from the ninth.

Its *integuments* adhere very strongly at the navel, whence the funnel-shaped appearance which it presents in some fat persons. On the median line the colour is deeper, and hair is met with in abundance in adult man. Externally, the skin is neither so white nor so regular as in the preceding region.

Further, it possesses no characters of peculiarity, excepting that it is more exposed to external injury, and that, extending much more during pregnancy and the developement of certain tumours, it is more frequently covered by wrinkles when the other tissues have re-assumed their natural position.

The *subcutaneous layer*, disposed as in the epigastrium, has, in addition, this peculiarity, that its laminæ approximate, uniting more intimately as they approach the umbilicus, with which they are blended. The adipose vesicles, as well as the blood vessels, are more numerous here.

With regard to the *aponeurosis*, its anterior layer belongs to the two oblique muscles, and the posterior is derived from the internal oblique and the transverse. In order to be convinced of there being four layers in this region, it will be quite sufficient to cut the external oblique muscle across, and turn it forwards, and then to make a similar incision through the internal oblique, and trace their aponeurosis. We shall then see that this latter soon folds upon itself, speedily separating, as if to

embrace the rectus muscle, blending very intimately with the layer of the external oblique anteriorly, and that of the transversalis posteriorly.

Umbilicus.—The linea alba, very strong, slightly contracted superiorly and inferiorly, is larger in the centre, where it is sometimes lozenge-shaped, having the navel as a centre. In the fœtus the umbilicus is the means of communication between the abdomen and placenta, by conducting the two umbilical arteries and vein, the prolongation of the allantoid and urachus, from the cord into the former: such, at least, is the disposition which my researches in embryogeny have led me to admit. The presence of intestine in the umbilical cord, up to about the second month of utero-gestation, is thence very simply and naturally explained. When the alimentary canal does not completely return, when the umbilical aperture is more contracted than usual, it is evident, that, under these circumstances, there would be *umbilical hernia.* The liver, and some other viscera, have been met with in these tumours, but they are, most commonly, formed by the intestines. In 1834, Dr. Dupuy showed me a fœtus, well developed in other respects, in which the whole of the digestive apparatus was thus situated out of the abdomen; and in 1819 I dissected another, in which I found exactly the same occurrence.

As the umbilical opening, at birth, is disposed so as easily to allow the exit of viscera, we should, even if it be merely as a precaution, examine the root of the cord, before we apply a ligature, and carefully avoid including any organ within it. If the intestines should remain in the cord, nowithstanding the ring be large, we should not despair of effecting a cure. The digestive function may return the viscera into the abdomen, and allow the opening to close insensibly. An infant, which I saw in 1835, proved this fact. The tumour, larger than my fist, had nearly a transparent envelope, and communicated with the abdomen by an opening of nearly three inches in diameter. Under the influence of gentle pressure, and the application of astringents, the tumour has insensibly returned, and the infant is cured.

The superior half of the ring forms an arch, adhering to the umbilical vein by loose cellular tissue. Below, its fibres, less regular and dense, unite more firmly to the arteries. The peritoneum, which invests and closes it posteriorly, forms a very slight cul-de-sac.

When the infant is separated from the mother, the vessels, urachus, and the ring containing them, blend, forming a fibrous knot, which ultimately becomes the firmest point of the abdominal parietes. The wound, or little ulcer, remaining after the division of the cord, cicatrises firmly, uniting the skin at this point; and as there is no fat, and as infiltration cannot occur, its thickness never varies. It appears prominent in thin indi-

viduals, and depressed in those suffering from anasarca. However, it does not always close so quickly, or so completely, but may enlarge during the first month, so as to admit the point of a finger, thus favouring the formation of herniæ. In addition, we may add, that in new-born infants herniæ traverse the ring of the umbilicus itself, whilst in after-life they commonly protrude through an artificial opening in the aponeurosis.

The circumference of the umbilicus after puberty is less solid than the cicatrix itself. The aponeurotic interlacement leaves in its neighbourhood several small natural openings, which, enlarging by distension, frequently allow the viscera to protrude. Ordinarily filled by fatty prolongations, attached to the peritoneum, these openings produce herniæ, containing fat here, as in other parts of the body. These, in some instances, are with difficulty distinguished from true herniæ.

Umbilical hernia, therefore, differs in every respect, as to its anatomical arrangement, from other herniæ. When the tumour is congenital, the organs displaced are all enveloped by peritoneum, a thin layer of fibrous tissue adhering firmly to the serous membrane, the subcutaneous layer, and, finally, by the skin, which is very thin. These several coverings are, frequently, so thin and transparent, in very young children, that the intestine may be seen through them. In the adult, the opening occurs sometimes superiorly, occasionally inferiorly, but more commonly on one side. When the hernia protrudes through one of the vascular openings in the aponeurosis, its reduction is exceedingly difficult, and its form nearly always rounded. Rarely acquiring any great size, it quickly becomes strangulated, in as much as these openings are strong, inelastic, and very narrow.

When the aponeurosis is torn in the median line, from any great effort, the peritoneum, adhering firmly at this point, sometimes yields at the same time; and the hernia is then deprived of its sac, as in penetrating wounds.

From these facts we learn, that, in operating for strangulated umbilical hernia, we may find its coverings presenting one of three arrangements:—Firstly, when there is no sac, the instrument has only to divide the skin and *superficial fascia*; secondly, when the peritoneum remains whole, it presents nearly the same indications as in other herniæ, excepting that it is thinner, and contains less fluid, and, consequently, requires more care to prevent its being injured; thirdly, where the affection is congenital, and the viscera have passed through the ring, the integuments are thinner, and the subcutaneous layer and peritoneum so intimately blended, that it is scarcely possible to distinguish them. In the latter case, as the natural opening has not lost its power of retraction, we may hope for radical cures in herniæ, before they are strangulated. In fact, the numerous cases related by Bichat, and others, prove this.

With regard to the contents of these tumours, they may be derived either from the small intestines, great omentum, arch of the colon, or stomach.

The separation of the aponeurotic fibres is not confined to the umbilicus; the linea alba may yield equally, towards the epigastrium and hypogastrium.

Muscles.—The rectus adheres by three points of its anterior surface, corresponding to aponeurotic intersections, not met with posteriorly. This disposition must be studied under three distinct relations:—1st, when abscesses form under the anterior portion of the aponeurosis, they are necessarily circumscribed; 2dly, these intersections give triple the strength which the muscle would possess if its fibres, stretched, extended uninterruptedly from the thorax to the pelvis; 3dly, they present a perfect example of the manner in which the two ends of a divided muscle reunite, and show how little foundation the ancients had for the assertion, that muscles cut across lose their power of motion.

The fibres of the *external oblique* are closer to the median line than in the epigastrium, particularly near the crest of the ilium. Those of the *internal oblique*, horizontal below, rise obliquely upwards, towards the external border of the aponeurosis.

The *transversalis* is the farthest from the median line. Its fibres are all horizontal, or slightly oblique. Although a repetition of the intercostals, it forms an uninterrupted membrane, on account of the ribs not dividing it into sections, as in the chest; the intersections of the recti are imperfect imitations of those bones. I have, in two instances, seen the apices of the three last ribs continued to the aponeurosis of the abdomen, by three fibrous intersections, perfectly similar to those on the anterior of the rectus.

The arrangement of these various muscles allows incisions to be practised on the median line, and to the extent of two or three inches external to the rectus muscle, without injuring them; but we should cut from above downwards, in the middle of the abdomen, and transversely on the sides.

Arteries.—These are similar to those in the epigastric region; with this difference, that the mammary artery and the intercostals do not descend to the termination of the region, whilst the epigastric, circumflexa ilii, and the lumbar are larger in that situation; another reason for making incisions as above recommended, to avoid hemorrhage. They must not, however, be carried too far outwards, as much blood might be lost from the lumbar arteries, which enlarge as they proceed from the loins.

In paracentesis, we introduce the trochar in the centre of the space, separating the umbilicus from the pubes, as much to avoid the arteries, as to find a depending point. The *anterior iliac*

and the last *lumbar* send branches to this part, sometimes of sufficient size to produce considerable hemorrhage, in wounds of this region.

In the cæsarian operation, and paracentesis, the great object is the best point of selection. This is, undoubtedly, the linea alba. On the side we successively divide,—

1. The skin.

2. Superficial fascia, enclosing branches of the superficial arteries and veins.

3. The abdominal aponeurosis, or the cellular layer of the external oblique, and this muscle itself, quite externally.

4. The internal oblique muscle, arterial, venous, and nervous branches.

5. The transversalis muscles.

6. Fascia transversalis.

7. Fascia propria.

8. Peritoneum.

In pursuing the method of Lanversat, we should equally have to divide the skin, subcutaneous layer, thin membrane covering the external oblique muscle, the fibres of this muscle, those of the internal oblique, fascia transversalis, and peritoneum; but, the incision being parallel to the transverse muscle and principal arteries, the muscular contraction and hemorrhage would be of less importance than in the lateral operation.

Moreover, by bending the trunk forwards, we easily bring the edges of the wound together, the external angle forming the most depending point. Union also ensues more quickly from the abundance and elasticity of the cellular tissue.

Veins.—Some, ramifying in the superficial fascia, occasionally acquire considerable magnitude, and accompany the subcutaneous arteries, terminating in the epigastric region; others are distributed like their corresponding arteries. As for the rest, the union between the vessels of the superior and inferior portions of the trunk occurs here. We find a free anastomosis between the branches of the subclavian and external iliac, the thoracic wtth the abdominal aorta, by which circulation is continued, after obliteration of the external, internal, or primitive iliacs, or of the aorta itself. The same may be said with regard to the venous anastomosis, relative to the vena cava.

A very important peculiarity has been mentioned by MM. Meniere and Manec. Under the observation of the first, a very large anormal vein, arising from the external iliac, proceeded to the umbilicus, after having run along the side of the linea alba, contiguous with the umbilical ligament, and, finally, opened into the vena porta. In the case related by the second, the vessel, proceeding by two roots from the same point, was parallel to the umbilical artery, formed a curve external to the navel, entered into the abdomen, and also opened into the sinus of the

vena porta, but without communicating with the hepatic ligament. These irregularities require all the prudence of the surgeon, in operations near the umbilicus, or in the hypogastrium. I have myself seen a more remarkable instance. The subcutaneous veins of the hypogastrium had acquired an enormous degree of developement. Arriving at the umbilicus, they united, by a trunk, as large as my finger, with the hepatic veins.

The *lymphatics* are very numerous, but there are no glands. These are arranged in two layers; those above the umbilicus proceed to the axilla or chest, traversing the epigastrium; those beneath descend to the groin or pelvis. This arrangement should be remembered in rubbing in for venereal or other diseases, and also as a reason for metastases or sympathetic mischief, occasionally produced by affections of the umbilical region.

Nerves.—This region contains merely filaments of the two last intercostal branches,—the first lumbar, and the ilio-scrotal nerve, neither of these being of any importance.

Cellular tissue.—In the sheath of the rectus muscle there is, anteriorly, a thin layer, where it is interrupted by the intersections; thin, also, posteriorly, but continuous and slightly adherent, allowing fluid to infiltrate and spread, upwards or downwards. Between the aponeurosis and the peritoneum, this cellular tissue is dense and compact on the median line, but less so over the sides, and inferiorly, where the fascia transversalis becomes distinct. Between the two oblique and the transversales muscles, it is reduced to very fine lamellæ, rarely enclosing fat. In this, as in other regions, the peritoneum supports a certain quantity of adipose appendices, augmenting in number and volume with age and en-bon-point. This layer also supplies the vessels with sheaths, which invest them.

Thus, abscesses and ecchymosis, situated in the sheath of the rectus, cannot extend over the sides, but are obliged to point either forwards, or towards the cavity of the abdomen, or spread into the epigastric or hypogastric regions. Externally, on the contrary, among the muscles, they can extend, laterally, into the iliac fossæ, &c.

Flanks.—Limited, superiorly, by the margin of the thorax, inferiorly by the crest of the ilium, in front by the umbilical region, and posteriorly by the mass of sacro-spinal muscles, the flank is much less extensive than the preceding. Externally, in fat subjects, particularly females, it presents, inferiorly, a sort of pad, occasionally very large; in others it is excavated, and continuous with the lateral depressions of the abdomen.

Skin.—The integuments are, generally, much thicker in this region, than anteriorly. Their character assimilates with that of the dorsal region. The skin is not covered with hair, but encloses numerous crypts. Though dense and firm, it is elastic, and permits of considerable developement, in subcutaneous tu-

mours. Its solutions of continuity are thus easily united, and indicate the employment of suture or adhesive plasters.

Above, below, and *in front* the *subcutaneous layer* is but slight, but posteriorly forms a considerable mass, filling the *cavity of the flank*, or the depression situated between the last rib and the crest of the ilium, the posterior margin of the external oblique, and the longissimus dorsi and sacro-lumbalis muscles. Composed of adipose cellules, very small, vascular, and nervous filaments, fibro-cellular tissue, the filaments of which, frequently interlacing, form numerous septa, adhering firmly to the skin and aponeurosis. In consequence of this cellular tissue, there is nearly always a visible depression above the haunch in anasarcous and fat subjects. Posteriorly, beneath the last rib, this layer is continuous with the cellular tissue of the interior of the thorax, so that pus may descend from the chest or abdomen, under the skin of the loins, giving rise to collections requiring much attention, as the abundance of cellular tissue frequently induces idiopathic abscess.

When these are insidiously developed, constituting what are termed *chronic abscess*, they are with difficulty distinguished from the former. The resistance of the skin opposes their bursting externally, and, consequently, forces them to spread over a considerable surface. When the aponeurosis yields, either near the rib or crest of the ilium, the pus burrows behind the peritoneum, and may thus form deposits, contrary to their usual method of developement.

In 1825, a man, aged twenty-eight, died at the Hôpital de la Faculté, who had always been strong and healthy, until three years previously, when he suffered considerable pain in his loins. In the course of five months a tumour formed, of the size of a child's head, in the left side. The collection extending to the front of the last rib, did not here penetrate the abdomen, but descended, between the ilio-lumbar ligament and iliac crest, to the fossa, which was full of pus, but there was no caries. The subcutaneous layer was the primitive seat of mischief, and the pus had only penetrated into the pelvis, from the anatomical disposition of the parts; in consequence of which disposition, and to avoid danger, these abscesses should be opened early, and largely.

From the proximity of the inferior cul-de-sac of the pleura, effusions of blood in the chest are, frequently, followed by considerable ecchymosis at this point; and pus in empyema, or from vomices, may equally find exit. Among other examples which I could cite, I will mention that of a man, in which the lumbar abscess had been taken for vertebral, but was, in fact, continuous with empyema in the right pleura; and of a boy who, succeeding effusion in the chest, had an abscess in the loins, and vomited pus, in considerable quantities, and in such a manner that, during a year, he spit up daily several glasses of pus, when

the abscess did not discharge; ceasing this expectoration suddenly, when the fluid recommenced flowing from the loins.

Aponeurosis.—It is in the cavity of the flank that the three portions of the *lumbar fascia* unite, to form one, which soon gives origin, by its anterior border, to the transversalis. Cellular layers, given off from its external surface, invest the oblique muscles. Dense, compact, very thick in the centre, it is thinner as it approaches the floating rib, and becomes nearly cellular, superiorly and internally. It is, therefore, by this that suppuration is conducted from the pectoral and abdominal cavities to the loins. Continuous, inferiorly, with the ilio-lumbar ligament, it is, with respect to purulent effusions, much more predisposed, superiorly, inferiorly, and posteriorly, whilst hernia forms where its fibres unite with the muscular tissue.

Muscles.—The *latissimus dorsi*, ascending to the chest, crosses the posterior superior angle of this region. The principal cellular mass lies on its anterior surface. Fistulous ulcers, succeeding lumbar abscess, are almost always superior internal and posterior, so that to expose them, it is often necessary to cut through the border of this muscle; and even then, we might be led to suppose that the pus flowed from some deep-seated parts, when, in fact, it is limited to the cellular tissue.

The *external oblique* has no aponeurosis. Its posterior border, enveloped by the lamellæ of that of the transversalis, descends from the last ribs to the iliac crest, crossing the external surface of the internal oblique, nearly at right angles, leaving it exposed, posteriorly and inferiorly.

The *internal oblique* is attached to the inferior border of the twelfth rib, and covered, in front, immediately by the latter, superiorly and posteriorly by the latissimus dorsi, and in the rest of its extent by cellular tissue and skin. A thin layer of lamellous tissue separates it from

The *transversalis*, which is prolonged, posteriorly, rather more than the others by its *fascia*. Otherwise it is covered by, and almost blended with, their posterior margin, separated from the peritoneum by the *transversalis fascia.*

The excavation of the *flanks*, nearly triangular, is thus circumscribed by the sacro-spinal and latissimus dorsi posteriorly; anteriorly, by the posterior border of the external oblique; and by the crest of the ilium inferiorly, which is its largest portion. Hence it results, that the walls of the abdomen are, here, very thin, and that the viscera, forced by any effort, may separate them, forming hernia. In consequence of this arrangement, some surgeons consider that the aorta might, more easily, be reached, without implicating the peritoneum; and Callison proposed this situation as most applicable for the formation of artificial anus. Others have observed that, through it, foreign substances might be removed from the colon, or calculi extracted from the ureter. It appears, even, that this latter

operation has been attempted on the living body, if we may rely on the assertions of Hobson. However this may be, there is reason for surprise that Douglas, who rejected this, could not even expose the kidney in the dead body. In fact, without stopping to question the possibility of the indications ever being sufficiently positive to justify us in attempting to extract a stone from the kidney, I do not see the difficulty of the operation.

We should have to divide,

1. The very thick skin.
2. Cellulo-adipose tissue.
3. Origin of the transversalis muscle, or its aponeurosis.
4. A second layer of cellulo-adipose tissue.

The kidney then lies on the anterior surface of the quadratus lumborum muscle, beyond which it extends two or three inches, outwards, beneath the last rib.

The *arteries* are given off by the lumbar, ilio-lumbar, external iliac, some branches of the phrenic, internal mammary, and last intercostals. The former situated, at first, between the fascia and peritoneum, and between the peritoneum and transversalis muscle, traverse the latter, run between it and the internal oblique, terminating in the external oblique and latissimus dorsi. The others all ramify in the muscles, forming a plexus similar to that in the umbilical region; their principal branches pass transversely. These vessels, being under the peritoneum, may easily be avoided in penetrating to the abdomen or kidney.

The *veins* emptying into the epigastrics in front, into the substernal and intercostals superiorly, the external iliac inferiorly, and lumbar posteriorly, accompany the arteries, having several branches in the subcutaneous tissue, and are too small to cause any inconvenience.

The *lymphatics*, as in the umbilical region, take two courses. Some run to the axilla and chest, others descending to the groin or pelvis. There are very few of them.

Nerves.—The branches found in the umbilical region also supply the flanks. The last intercostal nerves, and the first branches of the lumbar plexus, equally supply this part. They, like the vessels, run tortuously in the muscles, and are in no way remarkable.

Cellular tissue.—Between the peritoneum and transversalis muscle, this membrane forms a thin compact layer, which, becoming thicker and more elastic, sometimes contains fat as it approaches the quadratus lumborum muscle, where we shall again meet with it. It communicates with the intermuscular lamellæ, on the one hand, and with the cellulo-fibrous tissue of the flanks, on the other, by several openings in the aponeurosis, which multiply superiorly. As, on the other hand, the cellular tissue of the inferior surface of the diaphragm here presents itself, in addition to that of the posterior of the thorax, we may

consider the cellular mass of the flanks a rendezvous for almost all the cellular layers of the back.

Relative position.—From the exterior, towards the cavity of the abdomen:—

1. Skin, thicker posteriorly than anteriorly.
2. A thin filamentous tissue, between the latissimus dorsi and skin.
3. This muscle, but only internally and superiorly.
4. The cellular, again very thick internally, becoming much thinner externally.
5. The aponeurosis of the transversalis posteriorly, rather more anteriorly. The muscle itself, the internal oblique, and, quite externally, the external oblique.
6. The subperitoneal cellular tissue, more abundant and loose posteriorly, thinner and less extensible anteriorly.
7. Peritoneum.

In abdominal herniæ, manifested between the external oblique and latissimus dorsi muscles, the viscera would be enveloped by skin, subcutaneous layers, the peritoneum, with its cellular layer, fleshy fibres, or aponeurosis.

Lumbar region.—Limited, superiorly, by the dorsal surface of the thorax, inferiorly by the posterior portion of the hypogastric circle, and, laterally, by the flanks, this region is larger in its centre than laterally, in consequence of the approximation of the crest of the ilium and last rib. Its concavity, but little marked in infancy, more visible in individuals who are in the habit of keeping the chest and pelvis considerably thrown backwards, augments among pregnant women. When we lie on our backs, this concavity is effaced, but reappears immediately upon our resuming the upright position.

Having a direct tendency to approximate or prolong the axis of the trunk from that of the abdomen, these variations must have some influence on the mechanism of labour, and the formation of herniæ. In the former case, the viscera push against the umbilicus or iliac fossæ, and tend to escape from the cavity of the abdomen, whilst, in the latter, they are, more especially, rolled towards the pelvis.

A fissure, increasing in depth as it approaches the sacrum, occupies the median line of the loins, corresponding to the spinous processes of the vertebræ. Prolonging that of the dorsal region, better marked in the upright position, and in muscular or fat subjects, it makes the spine appear more deeply seated. Among children, and old persons, when the chest is inclined towards the pelvis, and in thin individuals, it scarcely exists, and then the spinous processes project considerably. Externally, are two prominences, susceptible of the same variations as the median fissure. Superiorly, close to the flank, we may easily feel the twelfth rib, and, inferiorly, the projecting portion of the crest of the ilium.

This is the part of the body where the *skin* is thickest. In other respects, it resembles that of the back, from which it differs merely in having a few transverse wrinkles, depending on the motions of the trunk.

The *subcutaneous layer*, consisting, over the sides, of lamellæ, filaments, fat, and vessels, compact and fibrous over the median line, unites the skin firmly to the supra-spinal ligaments, whilst, externally, the integuments and aponeurosis have but slight adherence. Thus, abscesses rarely occur in the median line; and, moreover, when they form on both sides at once, they do not communicate, but, on the contrary, extend towards the flanks.

The *first aponeurotic layer* of the loins, attached to the posterior fourth of the crest of the ilium, and to the spines of the vertebræ, gives origin, by its superior margin, to the fascia of the latissimus dorsi. That of the serratus posticus inferior, also, detaches itself in the same direction. Externally, it plunges into the cavities of the flank, assisting in forming the fascia of the transversalis muscle.

Destined to convert the spinal fossæ into a canal, this aponeurosis firmly binds down the longissimus dorsi and sacro-lumbalis muscles. It is exceedingly thick, its fibres interlacing in all directions, and is, consequently, rarely torn by the efforts of the muscles. Its extensibility is very limited, which favours, in a great degree, the action of the subjacent muscles, by keeping them firmly pressed down during their contractions.

The *second* aponeurosis, arising from the apices of the transverse processes, by as many slips, which, enlarging, blend with one another before they emerge from between the quadratus lumborum and sacro-spinal muscles, allows the transit of morbid fluids, from the cavity of the abdomen to the vertebral fossæ. Externally, this aponeurosis unites completely with the preceding; superiorly, it is attached to the last rib, and joins the *third layer*.

This latter, much thinner than the other two, is continuous, superiorly, with the ligamentum arcuatum of the diaphragm, and, inferiorly, with the ilio-lumbar ligament. Simply cellular, between the psoas muscle and base of the transverse processes, it is not really distinct until it reaches the front of the quadratus lumborum, external to which it unites with the middle layer.

When pus forms, primitively, in the substance of the fleshy mass of the sacro-spinal and quadratus lumborum muscles, when it proceeds from disease in the vertebræ or soft parts, it runs in preference towards the abdominal cavity. The extreme density of the posterior, the inequalities of the middle, and the limit of the anterior layer, which are the anatomical causes of this tendency, show why abscesses, occurring in this region, spread so often into the pelvis or groin, and so rarely towards the nates, or beneath the kidnies.

Muscles.—The *sacro-spinal* is the largest and strongest. All the fasciculi, entering into its composition in the back, are, we may say, blended here, justifying the term *common mass.* It comprehends the sacro-lumbalis, longissimus dorsi, and semi-spinales muscles, and is enclosed in a complete sheath, formed, posteriorly, by the posterior layer of the aponeurosis, anteriorly, by the middle layer or posterior surfaces of the transverse processes, and, internally, by the spinous processes. This mass is long and very powerful, acting as a lever upon the vertebral column, and upon each vertebra in particular. Its external portion, inserted on the ribs, near their angles, acts equally upon these bones. In the vertical position, during walking, running, dancing, or carrying loads, the equilibrium almost entirely depends upon it. Thus, when fatigued, we feel a painful weight in this region. It would also seem that the sufferings experienced in the kidnies, after great and continued fatigue, often depend upon irritation or rupture of its fibres. Lumbago, also, frequently occurs here, producing severe pain on the slightest movement of the body.

The quadratus lumborum lies, on the one hand, between the last rib, the crest of the ilium, and ilio-lumbar ligament, and, on the other, between the origin of the aponeurosis of the transversalis, and the processes in front of which it is situated. Covered by a thin fibrous membrane, it is separated from the kidney and colon by a quantity of fat. It is, consequently, sheathed, anteriorly, as the sacro-spinal is posteriorly, and acts, principally, in fixing the chest to maintain its equilibrum, or, rather, to counterbalance the action of the scaleni during inspiration.

The *inter-transversales*, stronger than those of the cervical region, are placed between the two preceding masses, and traversed by the posterior branches of lumbar arteries and nerves.

The *inter-spinales* are almost blended with the sacro-spinal, and the *psoas* muscles appertain to the abdominal cavity.

Arteries.—The last intercostal, the four or five lumbar, and the ascending branch of the ilio-lumbar, are found in this region. Some branches of the external iliac and epigastric, also, supply this part. The *intercostal* soon leaves the twelfth rib, running obliquely, across the anterior surface of the quadratus lumborum, to the transversalis. The *lumbar* emerge from below the psoas, and pass transversely towards the same parts, each giving off three principal branches, opposite the inter-transverse spaces. *One* penetrates the spinal canal, through the interspinal foramen, and supplies the membranes of the cord. *Another*, running backwards, divides and sub-divides among the fleshy fibres, and terminates in the subcutaneous layer. The third, lying behind the great sympathetic and spinal nerves, supplies the fat and cellular tissue surrounding the kidney, but not the substance of this organ; it, also, gives some branches to the quadratus lumborum, external to which it terminates, in the abdominal muscles.

In consequence of this arrangement, hemorrhage need not be feared in operations, unless we penetrate beyond the quadratus lumborum muscle, and then not so much when the incision is made in the transverse as in the vertical direction.

The *veins* are larger than the arteries, communicating freely with the plexus, extending along the anterior wall of the vertebral column. If injected, through the iliac or cava vein, the fluid runs into the veins superior to this region.

The superficial *lymphatics* are continuous with those of the surrounding regions. The deep-seated, on the contrary, run principally to the mesenteric glands, and those at the side of the spine. Thus, blisters, moxas, or inflammation of the lumbar region, may be succeeded by swelling of the glands, of the axilla, neck, and also of the groin; whilst deep-seated abscess, or disorganisation of the inter-muscular cellular tissue, cause disease of the mesenteric glands.

Nerves.—The whole of the lumbar plexus is here situated; but, being enveloped in the psoas muscle, we will defer its examination until we come to the interior of the abdomen, only remarking, that the last intercostal and two first branches of the plexus run to the sides, over the anterior surface of the quadratus lumborum. The posterior branches of the spinal nerves, the only ones ramifying in the muscles, proceed, in a similar manner, to the corresponding intercostals. Finally, most of their branches ramify freely in the subcutaneous layer, retaining a considerable degree of magnitude up to their termination in the skin.

Lamellous, elastic, and frequently enclosing a considerable quantity of fat, between the peritoneum and muscles, the *cellular tissue* here constitutes a thick layer, continuous with the cellular tissue, investing the anterior of the spine and iliac fossa, and is frequently the seat of inflammation. Suppuration, confined, as it were, over the sides by the adhesion of the peritoneum to the transversalis muscle or its aponeurosis, may easily burrow towards the pelvis or thorax. The same element, in the sheath of the quadratus lumborum muscle, scarcely ever encloses fat. Very fine, and communicating in front with the preceding layer, between the attachments of the muscles, especially near the last rib, abscesses formed in one of these situations may extend into the other. That enclosed in the sacro-spinal canal, occasionally, presents fat in front of the posterior lamina of the aponeurosis. Several of its filaments, also, traverse this membrane, to unite with the subcutaneous layer. Between the fleshy fibres, it is delicate, in small quantity, and close to the rib; all its layers blend to become continuous with the cellular tissue of the excavation of the flank.

The *skeleton* comprises the five inferior vertebræ and their ligaments. The *bodies* of these bones, thicker as they descend, especially in front, there cause considerable convexity. The

cartilages, exceedingly strong, present the same disposition; they are so intimately united, that the bones will break ere they yield. The *spinous processes* are short, but large and horizontal, allowing the trunk to be carried very far backwards. The *inter-spinal* ligaments, uniting them, and filling their intervals, are quadrilateral, very strong, and yellow. The *supra-spinal* is, also, thicker here than in any other point of the column. The *transverse processes*, thin, horizontal, and wide apart, have been compared to the ribs, and, in their turn, allow of very extended lateral inclination. These different characters are all favourable to motion, which is enjoyed to a much greater extent in the lumbar, than in any other region of the spine.

The *articular processes*, in part performing the functions of the transverse, are placed perpendicularly; the inferior look outwards, and are very close to each other. The superior, more separated, look inwards, presenting, posteriorly, a prominent tubercle, upon which the tendons of the semi-spinalis muscles are attached, instead of arising, as in the dorsal region, from the transverse processes. Hence these facettes are wedged one into the other, in such a manner, that they cannot slide in any direction; and, notwithstanding the free motion of the vertebral column, their luxations are impossible, unless combined with fracture.

The *laminæ* are short, thick, and broad; but those of one vertebra do not recline on those of another. Their horizontal position gives the yellow ligament the form of a square, and allows of its being seen, externally, to a certain extent. Thus, the point of an instrument, introduced perpendicularly to the axis of the body, would penetrate the spinal canal, without touching the bone.

The *spinal canal* is triangular, rather than round. The cellular tissue and fat are very abundant. Between the dura mater and the vertebræ the veins are very large, forming a complicated plexus; they run into the lumbar veins. The marrow terminates opposite the second vertebra; more inferiorly, we merely find nervous cords, enveloped in their neurilemmata, forming a fasciculus, commonly termed *cauda equina*. These are the nerves which supply the lower extremities. Several of these ascending as far as the ninth vertebra, injury of the spinal marrow, in the upper part of the lumbar region, is not always followed by paraplegia. From the preceding remarks, we observe, that if the portion of the spine, destined to protect the nervous system, is no longer sheltered by the ribs, it is, in lieu, sustained, against external injury, by its curvature, and the thick mass of muscles surrounding it. Being filled by so many vessels and arteries, presenting such a large areola, of so spongy a texture, and surrounded by so much cellular tissue, and such large ligaments, the vertebræ here present a degree of vitality, not met with in either of the other regions. This, in addition to the continued

motion of the part, sufficiently accounts for the frequency of caries, inflammations, &c. observed here.

In recalling what has been said of the posterior regions of the chest and neck, we shall not fail to remark, that the bodies of the vertebræ are more prolonged from their processes, as they approach the sacrum; whence it results, that the spinal canal, drawn forwards, is much more difficult to attain than more superiorly. In the dorsal region the transverse processes are directed strongly backwards; but as these eminences are, at the same time, very long, the vertebral fossæ appear deeper and broader. By these means, the laminæ of the bones of the spine are less apparent, and seem to be beyond the reach of an instrument.

Hypogastric circle.—This does not admit of the same division as the preceding. Its posterior half, divided into gluteal and sacral regions, belongs to the pelvis. Here we shall only examine its anterior division, limited, inferiorly, by a semicircular line, which, proceeding from the spine of the ilium on one side, passes over the symphysis pubis to the same point on the opposite. Its middle portion is the *hypogastric* region, and its sides the iliac.

Hypogastric region.—Externally, in fat subjects, the *hypogastrium* occasionally presents a transverse fissure, above the *mons veneris*, with which it is continuous inferiorly. In the median line, the groove, described in the superior regions of the abdomen, no longer exists. In pregnant women, it is, at first, the only point where the abdomen enlarges, ascending and projecting forwards; and we frequently remark, in those who have borne several children, as among all fat persons, a fold overhanging the mons.

Skin.—In man, it is covered by a considerable quantity of hair, especially below. During pregnancy, the median line is often marked by a brown streak, sometimes prolonged as far as the xyphoid appendix. Wherever there is hair, follicles are abundant, and, consequently, the sebaceous matter is secreted freely. The skin of this region, smooth, white, and delicate in young girls, becomes brown and corrugated with age. Its surface is marked by numerous wrinkles and folds, in women who have borne children, after ascites, and all diseases causing considerable and continued extension of the abdominal parietes.

The *subcutaneous layer*, thick inferiorly, there forms a very elastic cushion in fat individuals, and appears to arise from the linea alba, assisting in the formation of the fascia superficialis. Large abscesses may occur here, in consequence of its great thickness. This abundance of the subcutaneous cellular tissue being very favourable to the establishment of profuse artificial suppuration, gave the idea of applying setons in chronic affections of the bladder.

The *aponeurosis* requires an especial examination. The apo-

neurosis of the external oblique, arriving at the outer border of the rectus, splits, to invest the pyramidalis. If there is only one thin process behind the rectus, it does not arise from the posterior layer, common to the internal oblique and transversalis, being placed anteriorly, but from its not descending the whole length posteriorly. Thus, at this spot, the rectus is only separated from the peritoneum by the fasciæ transversalis and propria.

The *linea alba* is generally thicker and more contracted as it approaches the pubes, but during pregnancy it becomes thinner and much broader. Its fibres often unravel, the peritoneum, then being separated from the skin merely by the subcutaneous layer; so that, in subsequent pregnancies, the uterus may turn over the pubes, almost entirely leaving the pelvis; producing an enormous ventral hernia. Sennert relates two remarkable cases of this nature, and Rousset and Ruysch, each, another.

Thus, in the superior operation for lithotomy, a considerable thickness of parts must be traversed, besides the difficulty of reaching precisely the linea alba, in consequence of the muscles. M. Boudens recommends incising a little outwards, as practised by Roussit and others. In the cæsarian operation, on the contrary, the parts to be divided are reduced to the skin, a simple fold of subcutaneous tissue, and the aponeurosis, not thicker here than laterally.

Muscles.—The *pyramidalis* is frequently wanting, sometimes double, even treble, on one or both sides, and so close to its fellow, that there is only a mere fibrous interstice between them. It is also, occasionally, larger on one side than the other, and cannot always be avoided in puncturing the bladder. It acts as an extension of the abdominal aponeurosis. Enclosed in a complete fibrous sheath, its contraction is quite independent of the recti muscles, and its extremely variable thickness is inconvenient in the supra-pubic operation for lithotomy.

The *rectus*, not differing, at first, from the same muscle in the umbilical region, is, inferiorly, transformed into a flattened tendon, above two inches broad, becoming thin in its centre, being, as it were, before it is inserted into the bones, divided into two bands, between which the viscera might protrude. Its internal border, free, or confounded with the linea alba in front, is prolonged, from that of the opposite side, posteriorly, by a small triangular fossa, the base of which corresponds to the symphysis pubis, filled by very loose cellular tissue.

The external, thinner, appears to merge into cellular tissue, continuous with the internal portion of the fascia transversalis. Its transverse division would be more dangerous here than higher, as it is, we may say, the only one which can act on the pelvis; whilst, in the epigastric or umbilical regions, the large muscles would, in part, supply its place. As it is at the lower portion of the abdomen that there is most pressure on the

viscera, if we did not approach the extremities as nearly as possible, its retraction would not fail to leave a very weak cicatrix, liable to yield on the slightest motion. It occasionally contracts so violently during the superior operation for lithotomy, that it is necessary to cut its internal margin transversely; and certain authors have even gone so far as to make this a precept in all cases.

Arteries.—Some cutaneous branches ramify in the subcutaneous layer. Branches of the external iliac are found, superiorly, with the epigastric. Having wound round the cord, the *epigastric*, passing between the peritoneum and fascia transversalis, arrives at the external border of the rectus, behind which it runs, at about two inches above the pubes, and continues ascending to the umbilicus, following the course of the fleshy fibres. The internal branches are nearly double the size of the external; they are all transverse, and the greater portion ramify in the rectus muscle, forming numerous anastomoses on the median line.

We, consequently, run no risk of injuring the arteries, unless we penetrate beneath the recti; and even then, if the incisions are parallel, or slightly oblique, we only wound the secondary branches; an accident of less importance, the nearer it occurs to the median line. If the incision is transverse, we still avoid the trunk of the epigastric, by cutting open the union of the external with the two internal thirds of the muscle at its upper part, and directly outwards, when about two or three inches above the pelvis.

Its relations do not change. When, during pregnancy, or ascites, this artery runs more or less externally, this depends upon the linea alba, at these periods, acquiring a breadth of one, two, three, and even four inches, between the recti muscles, now become membraniform; thus, to leave the artery internal, we should cut very far, on the side; and, external, the large branches, running from it, would nearly always be cut across. The ascending branch of the external pudenda would lead to inconvenience in operations, when, as it sometimes happens, it has become much enlarged.

Veins.—We find a certain number beneath the skin, exceeding, considerably, the size of the corresponding arteries during pregnancy, and when the circulation is, from any cause, interrupted in the large abdominal trunks. We also possess some facts, proving that they are susceptible of becoming varicose. In the preparation which I have already mentioned, in speaking of the umbilicus, they had acquired the size of my little finger, and formed a plexus beneath the thinned integuments. The slightest incision on the hypogastrium would, necessarily, have been followed by considerable hemorrhage.

The epigastric, two in number, one internal, the other external to each artery, and nearer than the latter to the peritoneum,

are so disposed as to be sufficiently compressed by the uterus, during pregnancy, to prevent the course of blood, and produce swelling.

The superficial layer of *lymphatics* pass into the subcutaneous glands of the groin. Those of the deep layer all descend into the pelvis, whence it results, that to act on inguinal bubos, we should apply the mercurial frictions on the skin of the hypogastrium, and that the diseases of this latter region may be conveyed to the groin, whilst inflammation and deep-seated abscess re-act on the abdominal glands.

Nerves.—These, very few in number, very fine, and scarcely distinct, come from the lumbar plexus and last intercostal.

Beneath the skin, the *cellular tissue* forms, as we have seen, a very thick layer, which, continuous uninterruptedly with that of the surrounding regions, allows deposits to spread from one point to another, at the same time that its density, its areolar and filamentous disposition, cause abscesses to remain circumscribed, and effusions of blood to assume the form of abscess. Hence, morbid collections should be opened early.

The cellular tissue, in the sheath of the pyramidalis, may become the seat of inflammation, or abscess, without the surrounding parts participating in the mischief. In the canal of the rectus muscle, it forms two layers, one anterior, the other posterior, communicating with the former only at the upper part of the region, finally descending into the pelvis. The continuity of these two layers, differing so much from each other, is a fact which should not be forgotten, as it shows the danger of subaponeurotic suppurations of the hypogastrium, by explaining their passage to the side of the pelvis. A large abscess of this nature opened into the bladder in a patient, whom I attended in 1836; in another, the collection escaped from the pelvis across the hypogastrium.

Posteriorly, and on the median line, the cellular tissue is still more abundant. Its lamellæ are much separated. It fills the small fossa, perceived between the recti muscles above the pubes, and which disappears during pregnancy. The border of the pelvis is thus rendered more prominent internally, and in the delivery of an infant by the feet, having its face directed forwards, the chin may catch and arrest its progress. Corresponding to the bladder when distended, the tissue is the point of commencement of inflammation and infiltrations, succeeding lithotomy, or puncture, performed in the hypogastric region. The fat, separating it from the peritoneum, is also an object of the greatest importance in these operations.

Iliac region.—This region varies but little. In thin subjects it is generally excavated. Poupart's ligament then forms a very distinct border. Pregnancy, fat, and diseases distending the abdominal parietes, on the contrary, increase its prominence

forwards. It frequently presents a species of pad, descending as far as the groin.

The *skin* does not enclose so many sebaceous follicles, is not covered by so many hairs, neither does it offer the same density, thickness, nor adherences as in the hypogastrium.

Subcutaneous layer.—This layer has become, in our days, an object of peculiar attention. Its anterior portion, cribriform, always passing in front of the crural arch, without adhering thereto, unites with that of the thigh. Its posterior, or deep lamellæ, sometimes very dense, occasionally thin, present the character of an aponeurosis. It is this layer which Scarpa indicated under the name of fibrous expansion of the fascia lata, that Camper had already described, and which is universally known as the *fascia superficialis.*

When in its passage, in front of the crural arch, it unites, but in a less degree than described by Colles *; it is below that it appears to be attached, curving, so as to form a fossa, concave superiorly, and continuous with Gimbernat's ligament; and divided, by M. Manec, into two portions, one for the groin and crural arch, the other for the abdomen. Its continuity over the ring and in the scrotum, its adhesion beneath Poupart's ligament, explain why, after castration, or the operation for hernia, inflammation or suppuration is commonly diffused, extending nearly always upwards, towards the side or flank, rather than towards the thigh.

The *aponeurosis* of the *external oblique*, strongest here, is silvery, opaque, almost concealing the colour of the muscular tissue. Of its two orders of fibres, one *oblique*, downwards and inwards, commonly represents, more or less distinct bands, more separated internally than externally, and exposing the fibres of the internal oblique between them. This separation weakens the aponeurosis sufficiently for the viscera, pushed by the diaphragm, to form an oblong tumour above the groin, which may be ranged in the class of ventral herniæ, but must not be confounded with those of the inguinal region.

Poupart's ligament.—The fasciculus, extending from the anterior superior spinous process of the ilium to the tubercle of the pubes, and which may be termed the *ilio-pubic* band of the external oblique, is known as the *crural arch*, or *ligament* of

* This difference of opinion, between Messrs. Velpeau and Colles, appears to me to arise from their having overlooked the circumstance, of the fascia superficialis consisting of two layers at this point. When the integuments are reflected, we expose the anterior layer of the superficial fascia, continuous with that covering the thigh, and adhering but loosely to Poupart's ligament in its passage over it. If this be raised, we come down upon the posterior layer, a thin, clear membrane, composed of condensed cellular tissue, adhering firmly to the ligament. An excellent and recent description of this fascia is given by Dr. Todd, in the Cyclopædia of Anatomy. I, therefore, cannot do better than refer my readers to the article, Abdomen, in that work.—H. H.

Poupart or *Fallopius*. That it may be conveniently studied, we will consider it as possessing three margins; the inferior or *femoral*, continuous with the superficial division of the *fascia lata*. The principal portion of the external fascia falls obliquely upon the *superior*, at about two inches or an inch and a half from the symphysis pubis. The internal fibres of the aponeurosis leave this latter border to run and be inserted in front of the symphysis, interlacing with similar fibres from the opposite side, forming a triangular opening, which constitutes the *ring* or *external orifice* of the *inguinal canal*.* The band, circumscribing this opening, superiorly and internally, is called the *internal anterior*, or *superior pillar* of the ring; that forming its inferior border, the *external posterior*, or *inferior pillar*.

The *third border* of Poupart's ligament is the posterior or *iliac*. It is this which gives attachment to the *fascia transversalis*. Externally it is, as it were, confounded with the preceding, but, in separating from the spine of the ilium, it leaves a gutter between them, wider and deeper as it approaches the ring, and in which is found a portion of the internal oblique muscle.

The transverse fibres, or those of the second order, of the aponeurosis of the external oblique, few in number, are so arranged, that without them the preceding would form merely a web, whilst, by their assistance, we have a complete membrane, similar to those which have already been described in the epigastric and umbilical regions. The direction of these fibres is obliquely, from within outwards, diminishing in number as they descend, and almost lost in the *cellulo-fibrous membrane* covering them.

Less marked in children and females, they are much more developed in man, and always visible as they approach the ring or space between its pillars, considerably contracting this opening by covering its external or superior angle.† These become blended with a fascia, which will be described hereafter, as furnishing a covering to the cord. Finally, I must observe, in

* The student generally finds great difficulty in reconciling the terms internal and external rings with their relative situations, and for the following reasons. In the commencement of his studies, he is directed to regard an imaginary line, which would pass from the centre of the cranium, and terminate between the feet, dividing the body into two lateral halves, as the median line, or point to which all the parts composing the body are in such relation, that those nearest are termed internal, whilst the more remote are external. But when he arrives at the study of hernia, he finds that this arrangement no longer exists; that, in fact, without any feasible reason, the part close to the linea alba, and, consequently, near the median line, is described as external to another, situated midway between the anterior superior spine of the ilium and crest of the pubes, and, consequently, from an inch and a half to two inches external to it. All these difficulties would vanish if these rings were described and considered, the former as the *anterior* and *internal*, and the latter the *posterior* and *external*. The reason given, by some authors, for the present terms, namely, the position of the epigastric artery between the two, ought, in my opinion, to have reversed them.—H. H.

† These are the inter-columnar bands, giving off the fascia of that name.—H. H.

anticipation, that Poupart's ligament belongs neither to the former nor latter, as is generally supposed, but that, although united, they are, in point of fact, distinct, as we shall perceive in the inguinal region.

The *fascia transversalis*, thus named by Sir A. Cooper, and described more minutely by J. Cloquet*, arises from the iliac portion of Poupart's ligament, which it prolongs, at first, between the internal oblique and peritoneum, subsequently between the latter and transversalis muscle. It also arises from the internal border of the iliac crest, and forms the same relations with the quadratus lumborum. Inferiorly, it becomes more and more isolated, and appears to replace the aponeurosis of the transversalis muscle, as it is principally here that it assumes the aponeurotic character. Superiorly and externally to the external iliac artery, it is traversed by the spermatic cord, which divides it into internal and external portions. The first, attached as much to the border of the pubes as to Poupart's ligament, ascends parallel to the rectus muscle, thus running obliquely upwards and outwards. The fibres of the second are directed rather inwards, as if to reach the umbilicus, interlacing with those of the first, at from twelve to fifteen lines above Poupart's ligament, leaving between them the *ring* or *internal orifice* of the inguinal canal; a triangular or nearly oval space, larger below, the plane of which looks upwards and outwards.

This aponeurotic arrangement is not always evident, the fascia transversalis having often the appearance of a uniform membrane, without any distinct fibres. Its opening, in reality, no more exists than that constituting the crural ring; that is to say, each of these orifices sends an expansion upon the cord, continuing the two aponeuroses into the scrotum. Like that of the external oblique, it is, in certain cases, quite triangular, and much enlarged by the prolongation of its superior angle. Then, the two portions of the fascia transversalis are almost entirely separated, which is, doubtless, one of the reasons why anatomists do not agree in their description. In fact, it is only complicated from the variations in its thickness, and its adherence to the layers between which it is placed. To form a correct idea of it, it will suffice to recollect, that between the peritoneum and muscles it assimilates exactly to the thickness, and nearly to the regularity, of the aponeurosis of the external oblique, between the same muscles and the skin.

Muscles.—The *internal oblique* is formed of diverging fibres, which, inserted in the groove of Poupart's ligament, terminate on the aponeurosis, external to the rectus, the superior transversely, the inferior obliquely, or forming slight curves, convex anteriorly and externally. Close to the ring, they become paler,

* Mr. Guthrie, in his treatise on Inguinal Hernia, has given so correct a description of this fascia, that I would beg to refer my readers to that work.—H. H.

cross over the anterior surface of the cord, and give origin to the cremaster.

The *transversalis* follows the internal outline of the crest of the ilium, as the internal oblique does that of the rough crest. Its superior fibres are isolated without difficulty. The inferior are so intimately blended with those of the internal oblique, that it is difficult, if not impossible, to say whether they concur in the formation of the cremaster. I am inclined to think, from dissection, that they entirely disappear below. It is of little importance, whether they are really prolonged into the ring with those of the internal oblique, or whether the latter alone enter. The first, blending with the last, in terminating and being alone distinguishable below, appears to prove that the cremaster is wholly derived from it.

Arteries.—This region is traversed by three principal arteries; the *subcutaneous** of the abdomen, the *epigastric*, and *anterior circumflex*.

The first, which, as its name indicates, ramifies in the superficial fascia, beneath the integuments, always nearer the aponeurosis of the external oblique than the skin, enters the iliac region, by crossing the centre of Poupart's ligament. In its progress it gives off many lateral branches, generally very minute and unimportant.

The trunk itself, commonly too small to merit any attention, is occasionally of sufficient size to be important in certain operations, and probably its division has, in more than one instance, been mistaken for a wound of the internal epigastric.

The *internal epigastric*, placed internal to the opening in the *fascia transversalis*, ascends, in an oblique direction, to the hypogastric region, where we have already examined it. Behind Poupart's ligament, immediately beneath and internal to the spermatic cord, it gives off three branches, often by one trunk, which are small, but important.

The *first*, arising from its concavity, inclines directly upwards and outwards, enters the inguinal canal, and accompanies the cord.†

The *second* descends on the posterior surface of Gimbernat's ligament, furnishes a branch to the crural canal, and then anastomoses with the obturator. We shall refer to this branch when speaking of the iliac fossa.

The *third*, attached to the posterior surface of Poupart's ligament, runs transversely behind the body of the pubes to the symphysis, where it anastomoses with that of the opposite side. Sometimes, arising from half an inch to an inch above this point, it crosses the rectus muscle, and does not pass behind the pubes until it arrives at the median line. It is, very frequently, so large that we should avoid wounding it. When it emerges

* Superficial epigastric.—H. H.

† This is the scrotal branch of Sir A. Cooper.—H. H.

from beneath the cord, it may, if there be crural hernia, embrace the upper part of the sac. If its origin, on the contrary, were more elevated in internal inguinal hernia, it would be dangerous to cut either upwards, inwards, or outwards.

Immediately above the crural arch, the epigastric lies about six lines nearer to the pubes than to the anterior superior spine of the ilium, on the posterior surface of the fascia transversalis, to which it is attached by loose cellular tissue. Separated from the peritoneum, externally and posteriorly, by the fascia propria, it winds round the cord as it enters the inguinal canal. Although the umbilical artery runs along its internal side, it is always at sufficient distance for herniæ to protrude between the two.

Supposing that we would apply a ligature, as proposed by Boyros, we should expose the vessel with facility and certainty, by cutting in a direction parallel to Poupart's ligament. The inferior fibres of the internal oblique muscle being separated from it, by drawing them upwards, we should then come down upon the cord. Following its superior surface, we easily arrive at the opening in the fascia transversalis, which, divided, would expose the artery, accompanied by its veins, enveloped in a tissue, occasionally dense.

We have seen a similar artery to the preceding arising from the trunk of the iliac, placed upon the external side of the abdominal opening of the inguinal canal, and ascending obliquely outwards between the peritoneum and fascia transversalis. This branch may also arise much lower, and follow the same direction; but then it remains in the deep layers of the superficial fascia. Under all circumstances it may be divided, in cutting upwards and outwards, for strangulated inguinal hernia.

The *circumflexa ilii* is situated, at first, between the external oblique and the transversalis, and ramifies in the two obliques when it reaches the umbilical and lumbar regions. Its branches are generally small; but it may occur that that nearest the rectus muscle is sufficiently large to produce dangerous hemorrhage, if wounded in paracentesis.

The *veins*, distributed like the arterial branches, receive almost all the similar vessels contained in the hypogastric and umbilical regions. The *subcutaneous* are much larger than their corresponding artery, and each of their branches is attached to its trunk. Two, three, four, and occasionally a larger number, are met with, which sometimes dilate enormously, anastomose or interlace ad infinitum, producing a complicated network over the whole of the sub-umbilical portion of the abdomen, rendering the integuments livid, or black, and knobby. This varicose condition of the superficial veins of the abdomen has ordinarily a coinciding disposition in the lower limbs. These plexuses may, however, give rise to great difficulty in cæsarian opera-

tions, aneurism, herniæ, and even, upon cursory examination, be mistaken for one of those latter diseases. The two *epigastric* veins offer no peculiarity; unless it be, that, in inguinal hernia, when the tumour has acquired any magnitude, it may press upon them, producing a varicose state of the vessels.

All the superficial *lymphatics* descend into the glands of the groin, whilst the deep run into the iliac fossa or pelvis. There is no gland remarked at this portion of the abdominal walls, nor between the aponeurosis, and skin, nor peritoneum, and deep *fascia*, excepting opposite to the superior border of Poupart's ligament, where there are several.

The *nerves* are furnished by the lumbar plexus, principally, by the ilio-scrotal and genito-crural branches. The first, placed between the peritoneum and transversalis muscle, crosses its fibres, follows the crest of the ilium and the groove of the crural arch, pierces the internal oblique before arriving at the ring, and makes its exit through this opening, finally terminating in the scrotum. The second, coming from the iliac fossa, enters the inguinal canal, with the cord which it accompanies. Near the iliac spine, are also some branches of the inguino-cutaneous.

Between the internal oblique muscle and external aponeurosis the *cellular tissue* forms a fine lamellous layer, slightly adherent, more abundant near Poupart's ligament, and particularly near the ring, where it contains several adipose vesicles. Between the transversalis and internal oblique, there exists another very thin layer, which only communicates with the first by means of the fascia transversalis, or cellular sheaths of the fleshy fibres. The lamellæ, uniting the transversalis fascia to the muscles, constitute a third, which, dense and compact superiorly, is much looser and more elastic near the iliac fossa.

Notwithstanding we have described the cellular tissue, uniting the peritoneum to the fascia transversalis in all the abdominal regions, it nowhere merits so much attention as in the iliac region. Elastic, it everywhere forms a true membrane, furnishing sheaths to the epigastric vessels and umbilical artery, and finally penetrates the inguinal canal, to unite with the proper tunic of the cord. Most frequently so distinct and strong as to appear almost a peculiar aponeurosis, to which Sir A. Cooper gives the name of *fascia propria*, it may still be considered as separated from the peritoneum, on the one hand, and fascia transversalis on the other, by loose cellular tissue. It is not uncommonly stronger, and more evidently fibrous, than the aponeurosis lying externally to it. We may, consequently, explain how it is that anatomists have advanced, and very recently too, that the fascia transversalis is prolonged behind the rectus muscle, and descends into the iliac fossa. Its adipose vesicles, fixed or not by a pedicle to the external surface of the peritoneum, when extraordinarily developed, nearly always form adipose herniæ.

Inguinal canal.—By this name is understood that portion of the abdominal parietes traversed by the spermatic cord. Its direction is oblique from above, downwards, inwards, and forwards. As a canal, it is from one to two inches long. From the internal portion of the pubic opening it is three inches to the exterior of its iliac orifice, and about two inches from the latter to the anterior superior spine of the ilium.

Its *external* or *anterior wall*, formed by some fibres of the internal and aponeurosis of the external oblique, is the strongest, and necessarily so, as it has to oppose the expulsion of the viscera. Continuous superiorly with the abdominal parietes, it may become thinner, distend, and allow the organs to protrude, forming a species of abdominal hernia above Poupart's ligament.

Its *posterior* or *pelvic wall*, constituted by the internal portion of the fascia transversalis, is much thicker and stronger as it approaches the pubes. Posteriorly, this wall may be divided into two portions. The first of little extent, situated between the posterior opening of the canal and the epigastric artery, forms a part of the excavation or external inguinal fossa. When the viscera protrude here, it is called *external inguinal hernia.* Limited by the epigastric artery externally, and by the umbilical internally, the second corresponds to the *internal inguinal fossa.* When the organs are here implicated, they commence by approximating the two walls of the canal, subsequently emerging through the external ring; the hernia is then called internal inguinal. A third depression, which may be named inguino-vesical fossa, extends from the umbilical artery to the external border of the tendon of the rectus muscle, forming the bottom of a small triangular depression, by which herniæ may also escape. The viscera, in this case, are directed slightly outwards to escape through the external orifice; otherwise they would press against the posterior surface of the internal pillar of the ring, and could then only escape by separating its fibres.

There is, properly speaking, no *superior wall;* at least it is only formed by the fibres of the internal oblique filling the space dividing the external aponeurosis from the transversalis fascia. It is important to notice, that the cellular tissue, reuniting the parts in this canal, is elastic, allowing the fibrous layers to be easily separated. This may occur to a great extent in attempting to reduce herniæ. Two results may then ensue: 1st. The viscera may enter after having traversed the muscular layer, in which case inflammation is promptly followed by the formation of a great quantity of pus, and the posterior wall of the abscess, being much thinner than the anterior, may open into the abdomen, particularly as the fluid escapes through the ring in the fascia transversalis. 2dly. In this manner a kind of pouch is formed, in which the organs may be left by the surgeon, considering the reduction as finished, and then, besides the accidents above mentioned, if the abdominal orifice

of the canal be the seat of stricture, others ensue, leading to the death of the patient.

These facts are well understood in the present day. I first pointed them out.

The *groove of the crural ligament*, larger near the external ring than towards the os ilii, is nearly five lines wide in the former direction, whilst in the latter it is transformed into a simple edge. The *strongest wall* of the inguinal canal, it is nearly always upon it that the cord lies in herniæ, even if internal. The space traversed by the cord is not, therefore, a simple ring, but a true canal or tract, as described by Gimbernat, in 1787. We should, however, be wrong in considering it as always thus; at birth the two openings of this canal nearly exactly correspond, forming but one. It is only towards puberty or manhood, that its entrance appears to approach the ilium; whilst the ring, properly so called, remains in the same relations with the pubes. This change is explained by the enlargement of the pelvis during infancy. The pillars of the ring being attached to the body of the pubes, the opening in the fascia transversalis is obliged to follow the ilium, which spreads gradually towards the side. We may establish as a general rule, that the two openings of the inguinal canal approximate and correspond more nearly, the younger the subject. Inguinal hernia is more frequent in children than adults, although the latter are much more exposed to the exciting causes. They are frequently cured before adolescence, whilst, later, nothing can subdue them.

The *posterior orifice* nearly corresponds to the middle of the space between the iliac spine and pubes, looking upwards, outwards, and backwards, whilst the external ring is inclined downwards. The cord presents three different courses, in the form of an elongated Z. Thus, in the taxis, pressure should be applied at first upwards and backwards, and then obliquely outwards. But it is rarely that hernia, which is large, or of long standing, does not modify this direction. When the displacement does not occur all at once, the abdominal orifice dilates, enlarges, and is at length pushed towards the pubes. A little later, the external opening, forced in its turn to yield, being unable to dilate or move, excepting at its external and superior angle, is, as it were, thrown back towards the iliac spine, and the two openings of the canal almost immediately correspond. We may form an exact idea of this mechanism, by supposing, with Scarpa, that two powers draw upon the cord in an inverse direction, by its two extremities.

The inguinal canal is filled by the cord, which, at first composed of the vas deferens, spermatic artery, and veins, of nerves furnished by the great sympathetic, of some remains of the ancient vaginal tunic, cellular tissue investing the peritoneum, a third layer detaching itself from the circumference of the

opening in the fascia transversalis,—subsequently of a prolongation of the cellular layer existing between this aponeurosis and the muscles, gradually becomes enveloped in a fresh sheath, at the expense of the internal oblique muscle, and, on quitting the ring, with several other layers, blended one with the other.

The *artery*, veins, and vas deferens form the central part of the cord, but so that the artery and deferential canal are almost always posterior, whilst the veins are in front. The filaments of the genito-crural nerve, and the epigastric branch, ordinarily placed internally, are again enclosed in the deep cellular sheath. The ilio-scrotal nerve, on the contrary, runs between the cremaster and the fibrous tunic. Thus we see, that the vessels generally lie on the groove of Poupart's ligament, which exposes them to injury, when we cut directly upwards, in femoral hernia.

The iliac portion of the abdominal parietes is much weaker at some parts than others. For example, it offers less resistance between the ilium and cord than between this latter and the pubes. The former plane, directed obliquely downwards and inwards, representing a kind of groove, leading to the internal orifice of the inguinal canal, external inguinal herniæ are much more frequent than internal.

A *gland* of the iliac region, lying occasionally in this canal, deserves especial attention, on account of the errors to which it may lead. We can understand, that if it inflames, serious mischief may ensue, and that its swelling may form a projection externally, easily mistaken for bubonocele, for a cyst of the cord, or even for the testicle, when this organ has not descended into the scrotum.

Inguinal canal, in its relation with herniæ.

External inguinal herniæ.—The viscera, a portion of the intestine, for example, pushing the peritoneum and fascia propria before it, envelopes itself, in protruding, with fascia transversalis, fleshy tunic, the fibrous sheath detached from the circumference of the external ring, fascia superficialis, and skin. Arrested in the canal, it forms an elongated tumour, easily distinguishable in thin individuals; not so in fat. Then the sac, also elongated, resembles the finger of a glove, or rather a funnel, and not a true pouch, as in complete herniæ. In one case, as in the other, the cord, remaining posteriorly and internally, commences by becoming flattened; and if the disease increases in size, it soon becomes transformed into membranes; and we may find the spermatic artery external, the branch from the epigastric internal, and the vas deferens, with the veins, behind. We must observe, that this spreading of the cord is only well marked external to the ring, and that, near to the internal orifice, the various constituent parts are but little divided.

Here the epigastric artery is internal to the neck of the sac,

which it encompasses by a half circle. When the disease is recent, small, and the relative position of the two rings is but little altered, this vessel runs towards the rectus muscle, in a sufficiently oblique course to allow of cutting with impunity, directly upwards. The oblique incision, upwards and inwards, might then be unattended with danger. When, on the contrary, the hernia is of long standing, the artery drawn by the neck of the sac towards the median line forms a deep curve, and seems to ascend slightly outwards, and, consequently, would be wounded by cutting as above. The safest incision, therefore, is upwards and outwards: we should thereby avoid a second epigastric artery; and, if the superficial epigastric were divided, it might easily be secured. The danger and difficulty must vary according to the situation of the stricture. If the constriction be caused by the external ring, we may cut nearly in all directions, without running any great risk. If, on the contrary, it be at the internal opening, the instrument must necessarily be carried into the abdomen.

The internal epigastric artery is less easily injured, than Leblanc, and other modern surgeons, seem to imagine. As it is commonly some lines external to the internal opening, and the cellular tissue enclosing it is very elastic, it slides away under the pressure of the knife.

Congenital hernia of the groin is always external; and, having the epigastric artery to its inner side, we may cut, without fear, upwards and outwards. In the fœtus, the peritoneum proceeds gradually outwards, with a prolongation of cellular tissue. On the other hand, the testicle adheres intimately to the peritoneum at all points, excepting at its posterior border, which receives the vessels, the vas deferens, and the superficial aponeurotic ligament. Then, in entering the internal ring, it carries with it the serous membrane, and is suspended in the scrotum by a tubular ligament, adhering to it in an inverse direction to that in the abdomen. It is by the opening of this latter canal that fluids pass from the abdomen into the scrotum, forming congenital hydrocele, and that the intestines, and other viscera, become implicated in hernia of the same character. Though this closes naturally after birth, it sometimes remains open; whence we occasionally meet, in the adult, with hernia, enclosed in the same sac with the testicle.

In the adult female, the inguinal canal scarcely ever exists, excepting in the rudimental state. Inguinal herniæ, therefore, without being very rare, are incomparably more so in females than males.

In infancy the case is different; the tract through which the round ligament or the cord passes being only a simple ring, the viscera as easily escape in the girl as in the boy.

In *internal inguinal herniæ,* occurring in the fossa separating the umbilical ligament from the epigastric artery, or in the

excavation existing between the bladder and this latter, the organs must push before them,—

1. Peritoneum.

2. Fascia propria.

3. Fascia transversalis, which, not being sufficiently elastic to yield to any great extent, tears, when the tumour acquires any degree of magnitude.

4. The spermatic cord, and origin of the cremaster.

5. The internal pillar of the ring, or the fibrous sheath arising from this opening.

6. The fascia superficialis and skin.

It differs from that passing through the canal, in occurring by a single instead of a double opening, and running obliquely, from behind forwards, and not from without inwards; in not being obliged to traverse a canal; and in having the cord external, in front or behind, whilst in the former it is internal.

When the tumour is large, the epigastric artery may incline so much forwards, that it would be necessary, not only to avoid cutting outwards, but to carry the knife very obliquely, upwards and inwards. If the operator knows positively what species of hernia he has to treat, he might escape the vessel by cutting in the direction of a line drawn from the external orifice of the ring to the umbilicus. As the organs composing it separate or tear the fibres of the fascia transversalis, sometimes driving them forwards, instead of forming a natural opening, internal inguinal hernia is never congenital. Its constriction almost always occurs at the external ring, rarely on the neck of the sac, more rarely at the posterior opening; consequently, if we are content with cutting on the circumference of the external ring, without penetrating the abdomen, it is evident that the constriction will cease, and that, on whatever side the arteries be, we run no risk of injuring them.

Inguinal hernia is ordinarily single on one side; but we occasionally meet with two, and even three, very close to each other, in the groin. Petit considers, that, in the patients of whom he speaks, the viscera had not traversed the ring itself, but simply separated the tendinous fibres of its pillars. In treating of the aponeurosis of the external oblique, I have rendered the possibility of such an occurrence evident. In dissecting, however, we may prove, that double hernia may sometimes pass through the ring, although, posteriorly, its two portions do not enter the same opening. Wilmer says, that, in a subject which he examined, they traversed the inguinal canal side by side, each having a different sac. I have seen the same myself.

CHAPTER EIGHTH.

CAVITY OF THE ABDOMEN, AND VISCERA.

Considered as a whole, the cavity of the abdomen is oval-shaped. In well-formed women its largest extremity is downwards, whilst it is the reverse in the infant and man. Its vertical *axis* inclining to the right, accounts for the frequency of herniæ on that side, and varies with age, sex, and numerous other circumstances. In infancy, generally, among females, dropsical individuals, and during expiration, it is larger in proportion than in manhood, and during inspiration. It is formed of two principal planes, one anterior, and the other posterior, having their concavities directed towards each other, and approximating from above downwards, to unite at an acute angle on Poupart's ligament. The solidity of the posterior, with the convexity of the spine, throws the viscera forwards; but the contraction of the diaphragm, together with the reaction of the recti, quickly directs them downwards; and, consequently, they are, by these means, conducted to the bottom of the iliac region, rather than to the pelvis. The large muscles, the recti, for example, being separated by purely aponeurotic spaces, capable of yielding, allow of herniæ occurring, not only in the flank, umbilicus, on the linea alba, in the groin, but also on various other points of the abdomen, which terminates, inferiorly, in a small basin, or pelvic excavation,—a kind of appendix, which we will examine hereafter.

SECTION FIRST.

PROPER ABDOMINAL CAVITY.

Superior wall.—Formed solely by the diaphragm, the roof of the abdomen is prolonged upon all the other walls of this cavity. Its depth is extremely variable. Considered from before backwards, in the median line, it descends very low on the spine, ascends a little into the chest, inclining, consequently, downwards and forwards. Laterally, it is much higher, corresponding to the last true rib, and still more elevated on the right side, from the presence of the liver.

During forced expirations, and in infancy, or when the abdomen is greatly distended, the diaphragm may ascend as far as the sixth rib. Hydrothorax, empyema, and all thoracic effusions, may, on the contrary, diminish the size of the abdomen, by depressing its upper wall. The lateral excavation of the dia-

phragm forms, properly speaking, the hypochondriac region, whilst the posterior portion of this muscle corresponds to the epigastric and umbilical regions. The peritoneum, investing it in the left hypochondrium, adheres but slightly to it.

Supporting the liver by the *triangular* and *coronary* ligaments, the diaphragm is in immediate contact with this viscus, to the extent of several inches transversely, and of from one to two inches from behind forwards. Supporting the base of the right lung, abscesses, formed primitively in the substance of the liver, may be discharged through the bronchi, or where the pleura adheres but slightly to the lung, into the cavity of the thorax.

The fleshy fibres of the diaphragm appear to arise from the base of the thorax, where they interlace with those of the transversalis muscle. When its two planes contract simultaneously, the chest enlarges perpendicularly, without losing any of its transverse diameter. Converging towards the trefoil aponeurosis, which receives the divergence of the pillars at its posterior notch, they have their fixed point at the spine. The lateral portion of the diaphragm being much more mobile than the centre, the liver on the right, and the stomach on the left, are elevated or depressed in a very marked manner during respiration, whilst the heart, reposing on its middle portion, scarcely changes its position. In uniting to form the pillars, the muscular fibres circumscribe two very important openings: on the left side, opposite the first lumbar vertebra, enclosing the aorta and thoracic duct, the first is a fibrous ring, completed by the spine posteriorly, and so disposed that the vessel is not compressed during respiration.* The other, more anterior and closer to the median line, in front of the eleventh dorsal vertebra, entirely fleshy, susceptible of contraction, encloses the pneumo-gastric nerves and the œsophagus, the functions of which may be momentarily interrupted, without immediately compromising the life of the individual. The opening in the central aponeurosis, situated at about two inches to the right, in front of the œsophageal opening, is bounded by fibres interlacing in four different directions, and which are, it may be said, attached to the circumference of the vena cava ascendens. Thus, this vessel cannot be in any way compressed during the contraction of the diaphragm.

The *arteries*, *veins*, and *lymphatics*, are arranged very simply. The two arteries are so distributed that their anterior branches anastomose with the internal mammary and epigastric, and that their lateral branches, anastomosing with the intercostals and lumbar, forming a communication in case of obliteration of the

* The student must not expect to find this a ring, as it is, on the contrary, a canal, bounded, anteriorly and laterally, by the crura of the diaphragm, and posteriorly by the vertebræ. It is tendinous internally, or towards the vessels, and thus prevents compression.—H. H.

aorta, are, sometimes, of sufficient magnitude to bleed very abundantly, in penetrating wounds of the hypochondriac region.

Nerves.—Besides the proper phrenic, derived from the cervical plexus, and described with the chest, we meet with filaments from the eighth pair, which probably supply sensation, whilst the preceding appear to furnish contractibility. Those anatomists, who pretend that the diaphragm is primitively formed of two muscles, are mistaken. In the embryos of a month, which I possess, it is merely single. The passage of the abdominal viscera into the chest, does not invalidate this remark, as in the facts related by Leblanc and others, the anormal opening is not confined to the median line. I have seen several examples of congenital perforation of the diaphragm. In one, the stomach, a portion of the transverse colon, and small intestine were in the same cavity with the left lung. The opening, smooth and rounded, permitted the introduction of the extremity of the five fingers at once. In another, the opening occurred at the same point, was rather larger, and the spleen had traversed it. It is probable, therefore, that these openings are not the remains of natural division, but rather rents, the borders of which have cicatrised, either before or after birth.

Anterior wall.—The internal surface of the epigastric, umbilical, hypogastric, and iliac regions, present the umbilicus in the centre of the median line. To this pass four ligamentous bands, or three vessels, and the urachus, according as they are examined in the fœtus, or subsequent to birth.

Suspensory ligament of the liver.—One of these cords, passing obliquely upwards and backwards to the right side, terminates in the epigastric region, forming a falciform ligament of the liver, which becomes double behind the linea alba. Its adipose vesicles, most numerously developed, may form adipose herniæ, re-acting upon the liver. This ligament, which is merely the umbilical vein, enveloped in a fold of peritoneum, although habitually closed in the adult, may remain free, as seen by Boerhaave and others. Hence, an indication to cut towards the left side in freeing stricture, in the operation for strangulated umbilical herniæ, or where we are obliged to enlarge penetrating wounds of this region.

The *urachus*, descending perpendicularly to the summit of the bladder, along the posterior surface of the linea alba, appears to be a true canal, during the first months of intra-uterine life, leading into the bladder. It has been found existing at birth, and even at manhood, allowing the urine to escape through the umbilicus. Cabrol and Hildren have each cited a remarkable example. In this case the internal membrane, swelling, may protrude externally, sometimes forming a tumour in front of the navel, which has been described as a hernia, but which does not appear to me to merit this title. It is a condition resembling that frequently presented by the intestine in artificial

anus. As the umbilicus thus becomes hidden, it is probable that accidents of this nature have, more than in one instance, lead to the suspicion of absence of the umbilical cord in the newly-born infant. The observation of Wiel, in which the pubes of the infant was surmounted by a tumour, is, I consider, an example of this mistake. Occasionally, also, the linea alba unravels, as the bladder ascends towards the umbilicus. The pouch, then, may form a simple hernia above the opening; but, more frequently, the anterior wall, being more or less destroyed, its internal surface, drawing the orifice of the ureters into the opening in the abdominal parietes, represent a more or less thickened growth in front of the hypogastrium. Although this condition, which constitutes *exstrophia vesicæ*, may offer numerous varieties, commonly coinciding with other anomalies, which prevent the child from living beyond a few months, we, nevertheless, occasionally meet with individuals who have existed in this state during several years. There was a young man at the hospital at Tours, in 1820, who was eighteen years of age. In him, above the symphysis pubis, there was a red and fungous surface, as large as a five-franc piece, at the bottom of which, the two orifices of the ureters might be perceived, continually pouring out the urine.*

The two last cords, formed by the umbilical arteries, reduced to ligaments in the adult, have, between them, the bladder and urachus, two large triangular spaces, concave inferiorly, forming the inguino-vesical fossæ of the iliac region; narrow and superficial, on the contrary, near the umbilicus, which is here weaker and more liable to accidental herniæ.

Hence, the four cords form a more considerable prominence,

* There is, at present, (January, 1838), a man in St. George's Hospital, presenting the same malformation. He is strong and robust, and, from his account, is of a healthy family. There exists, at the lower third of the linea alba, a tumour formed by the anterior mucous surface of the posterior boundary of the bladder. When the patient lies on his back and remains quiet, this tumour measures, in its transverse, or greatest diameter, three inches and a half, and in its vertical, two inches and a half, and in its antero-posterior diameter, about two inches; the latter, however, during a fit of coughing, or when the patient is walking, may be increased to three inches. The mucous membrane is of a red colour, very painful to the touch, and covered by its own secretion, excepting at its superior portion, and also at the left side, where it has been transformed into skin. At its inferior margin may be detected the orifices of the ureters, that of the left side being more distinct than the right, constantly distilling urine, and occasionally giving passage to semen, of which there is frequent emission. Immediately beneath the tumour, on the median line, is the glans penis, the penis itself being scarcely developed. Altogether, it is about an inch in length, fissured on its dorsum, and covered with mucous membrane, continuous with that of the bladder. It has no opening continuous with the bladder. The recti muscles, which have their internal margins separated, superiorly, by the linea alba, pass, inferiorly, on each side of the above-named tumour, to be inserted into the upper part of the angles of the bones of the pubes, the latter not being in apposition to form the symphysis, but connected, at the distance of four or five inches, by a ligamentous band, on which the penis rests. The scrotum appears natural, but the testes rather less than usual. I cannot conclude this note without thanking Mr. Toynbee, and also Mr. Warwick, to whose kindness I am indebted for most of the above particulars.—H. H.

the farther they are from the umbilicus. Lying, at first, simply between the muscles and peritoneum, they become completely enveloped in this membrane, as they descend; thus, in very young children, the vessels and urachus are very likely to be injured, when the wound is near the umbilicus.

When, in hernia, the parts have really traversed the umbilicus, they may compress the vein and arteries, thus interfering with the fœtal circulation.

If the cicatrised umbilicus is the strongest, the surrounding portions are the weakest parts of the abdominal parietes, as observed by Colles. If umbilical herniæ are less frequent than those of the groin, it is because there is least stress upon the former. Scarpa maintains that they are never without a sac. It seems to me, as I have before observed, that the compactness and want of elasticity of the peritoneum, at this point, render the contrary, at least, probable.

Superiorly, and on the median line, is the superior surface of the xyphoid appendix. On its sides, the aponeurosis is weak. The space, separating it from the costal cartilages, rather wider on the left than the right, together with the presence of the liver, explains the great frequency of herniæ of the linea alba on this side of the xyphoid appendix, without admitting that they are formed by the stomach, rather than any other organ, as has been advanced by Garangeot and others. Quite inferiorly, and outwards, we enter the internal surface of the iliac region, where we find the three inguinal fossæ already mentioned.

Lateral walls.—The *lateral wall*, especially formed by the internal surface of the region of the flank, is continuous in rather a direct manner with the hypochondrium, on the one hand, and the iliac fossæ on the other.

The peritoneum, thick, strong, and adherent anteriorly, is very elastic posteriorly. Uniting with the posterior wall, it presents, superiorly, beneath the last rib, a slight excavation, corresponding to the thinnest point of the aponeurosis of the transversalis muscle, and inferiorly, near the iliac crest, a similar fossa, equally reposing on a thinned portion of the *fascia lumborum*.

Posterior wall.—On the median line, this wall presents the lumbar portion of the spine, dividing it into two equal parts, making a much more considerable projection in women than men. After a long fast, in thin persons, the anterior wall approaches it so nearly as almost to touch; at least, the vertebral column is easily felt by pressing on the umbilical region, and is thus, as I have often seen, mistaken for a morbid tumour. The organs, separating the lumbar vertebræ from the peritoneum, are numerous and important.

The pillars of the diaphragm, descending almost to the fourth lumbar vertebra, on the right, and only to the third, on

the left, are continuous, below, with the anterior ligament of the vertebræ.

The *aorta* descends, almost in a direct line, on the left side of the spine, slightly approaching the median line, to the front of the fibro-cartilage, uniting the fourth to the fifth lumbar vertebra, where this artery bifurcates, to form the primitive iliacs. In its course, it gives off, anteriorly, the inferior diaphragmatic, cœliac axis, superior and inferior mesenteric arteries; laterally, the renal, sur-renal, and spermatic; and, posteriorly, the lumbar branches and middle sacral. Long hidden by the fleshy fibres of the crura, it separates from them, so as to be visible in the abdomen only in front of the second lumbar vertebra. Anteriorly, it is covered above the cœliac axis by the semilunar ganglion; between the axis and the mesenteric artery, by the solar plexus; still lower, by the aortic plexus, or the fasciculi running to form the inferior mesenteric plexus. Its left side corresponds to the great sympathetic, which is particularly close to it at the sacro-vertebral angle. To the right it is, at first, separated from the vena cava by the corresponding pillar of the diaphragm. These two vessels then touch, or are separated merely by a thin fibro-cellular membrane, in which case varicose aneurism, either traumatic or spontaneous, may (as Lancisi reports, in the case of his servant,) take place between the aorta and cava, as between any other arteries and veins of the body. The *thoracic duct*, at first placed posteriorly, passes rather to the right, as it ascends and penetrates the peritoneum by the same opening. It is separated from the spine by a small quantity of lamellous cellular tissue and the prevertebral ligament.

As the aorta is covered immediately, anteriorly and laterally, by the peritoneum, afterwards, in the epigastric region, by the cardiac extremity of the stomach, splenic vein, lesser omentum, the right portion of the stomach, and the left lobe of the liver, cancer of the upper or lower portions of the stomach, or tumour of the left lobe of the liver, may produce considerable disorder of the circulation. Its aneurismal tumours of the epigastric region, in their turn, give rise to nausea, vomiting, thus suspending the digestive functions.

It is crossed, between the cœliac and superior mesenteric, by the pancreas; afterwards, beneath this latter, by the inferior portion of the duodenum. In addition, we find, between it and the anterior wall of the abdomen, the transverse mesocolon, the mesentery arch of the colon, a large portion of the small intestine, and the great omentum. Its pulsation can be easily felt in this region. The walls of the abdomen being very flexible, and the spine convex, it is, under certain circumstances, scarcely separated from the umbilicus, but by peritoneum and omentum; and if it should be wounded, it might be possible to suspend the hemorrhage, for a moment, by pressing firmly on the

left side of the spine, across the abdominal wall. By this means, we may suspend uterine hemorrhage, as I have advantageously tried upon several occasions. This would also be of the greatest assistance in ligature of either of the iliac arteries, for traumatic aneurisms especially.

Numerous glands, surrounding the aorta, from the cœliac axis to the sacro-vertebral prominence, may strongly compress it when they are the seat of scrofulous or other swellings.

It is, moreover, observable, that tumours of this artery sometimes project posteriorly, causing absorption of the bodies of the vertebræ, rather than anteriorly, and laterally, where there are only soft parts.

It is thus that aneurism of its posterior region may produce paraplegia, be mistaken for caries of the vertebræ, and, if it project into the lumbar region, resemble abscess.

We perceive, then, that to expose the aorta, by dividing the wall of the abdomen, the most convenient point would be that corresponding to the third lumbar vertebra.

The experiments on dogs prove, that ligature of the abdominal aorta is not absolutely fatal. I dissected a cat, upon whom M. P. Grandchamps operated five months previously, without any appearance of the animal's suffering much inconvenience, although the artery, between the two mesenterics, was converted into a solid ligament. Paris, Mechel, &c. have found the aorta so much contracted, that it would not admit a crowquill. Goodison, in 1818, found it quite obliterated in the body of a woman of forty. Several facts, of the same nature, have been related since. I have myself published a case, in which it was filled with a concrete and solid matter above the primitive iliacs.

By applying the thread above the inferior mesenteric, we preserve a free anastomosis, as this vessel runs directly into the superior mesenteric. There are, also, several others which convey the blood into the lower extremities. The communication of the lumbar arteries among themselves, of the same with the ilio-lumbar, circumflexa ilii, gluteal intercostals, lateral branches of the epigastric and phrenic, those of the epigastric with the internal mammary, the inferior intercostals, and inferior phrenic, &c. form so many anastomoses, that they would prevent circulation being destroyed in the parts beneath the thread. Nevertheless, it must be said, that its ligature, performed two or three times in man, only preceded the death of the patient by a few hours; and that, by penetrating through the loins, as recommended by Gerdy, we should not avoid any of the dangers.

The *lumbar arteries*, already described in that region, arise from the posterior portion of the aorta, cross the groove in the bones of each vertebra, and plunge into a kind of canal, formed partly by bones, partly by the psoas muscles, or by the small fibrous bands, by which they arise from the spine, and would be

torn, if, in tying the aorta, we endeavoured to raise it to any extent.

Crossed by the great sympathetic, genito-crural, and lumbar plexus of nerves, they enter the psoas magnus, after having given off their posterior branch, and terminate between the peritoneum and the quadratus lumborum.

The *vena cava*, to the right, and on a plane anterior to that of the aorta, in emerging from the diaphragm, places itself more posteriorly beneath the liver. The two vessels, at first separated by the lobulus Spigelii, immediately approximate, and are soon in contact. Anteriorly, the vein corresponds, superiorly, with the liver, which encloses it in its posterior fissure, receiving there several branches of some magnitude,—among others, the hepatic, before it traverses the diaphragm. Abscesses of the liver would easily open into it, were it not in the nature of vessels to present considerable resistance to ulcerous inflammations. When, as James has observed, purulent collections discharge into the inferior vena cava, or into the mesenteric vein, as seen by M. Robert, it is evident that death would at once ensue.

Covered directly by the vena porta, the excretory canals of the bile, the right extremity of the pancreas, perpendicular portion of the duodenum, renal artery, small omentum, pylorus, meso-colon, right spermatic artery, small intestines, and great omentum, the vena cava is prolonged from the vertebral column, at first, by the whole thickness of the right crus of the diaphragm, subsequently by the right portion of the semilunar ganglion. To the right it is in contact with the liver, the super-renal capsule, the kidney, and peritoneum. It results from these relations, that induration of the liver or pancreas, that cancer of the pylorus and mesenteric glands, and also, that aneurisms of the aorta, may prevent the blood from mounting to the heart, and produce dropsy; that they may even perforate this vein, project into its interior, filling it; or becoming dissolved, circulate with the blood, as I have frequently seen and published.

The *lumbar veins* accompany the arteries. Emptying into the vena cava, those of the left side pass beneath the aorta, in the same manner that the right lumbar arteries cross the posterior surface of the vein. This arrangement very rarely varies; however, we have met with the vena cava to the left of the aorta, between the primitive iliac and the emulgent veins. There it was greatly dilated. It afterwards passed in front of the artery, and ran as usual in the fissure of the liver.

Lying immediately on the bodies of the vertebræ, the lumbar vessels are completely out of the way of all compression from the muscles and other surrounding organs.

The *chain of lymphatic glands* and the *cellular tissue*, in front of the lumbar vertebræ, offer the same arrangement as in the pos-

terior mediastinum. As these glands form an uninterrupted series as far as the summit of the thorax, they account for the numerous encephaloid tumours met with between the layers of the peritoneum, from the sacrum to the neck, as a consequence of scirrhus of the testicle.

The *spinal nerves* here merit some attention. Their anterior branches anastomose with each other, and with the last intercostal, in front of the transverse processes of the vertebræ. Thus blended, and covered by the psoas, inflammation of that muscle considerably affects the lumbar plexus. The genito-crural nerve, traversing the fleshy fibres from behind forwards, lying upon the vertebræ, may be compressed by tumours developed in the abdomen. The ilio-scrotal and inguino-cutaneous branches, running nearly transversely outwards, between the quadratus lumborum and psoas muscles, soon terminate in the lateral region. Finally, the obturator and crural nerves, which will be described with the iliac fossæ.

The great sympathetic is here remarkable for its more anterior position, the irregularity of its form, as well as for its plexiform union over the pillars of the aorta. In fact, it is here, that the great splanchnic nerves emerge from the chest to anastomose, and produce the semilunar ganglion, that the lesser splanchnic spread in front of the emulgent arteries, and that all anastomose, mingling one with the other, as also with the filaments of the pneumogastric, to produce the solar plexus, and all the branches running from it; to form, in fact, that nervous centre upon which ancient practitioners laid so much stress, and which is alone capable of explaining the suffocating pains experienced in certain diseases of this region, or the danger of its contusion.

The *psoas muscles*.—The lesser psoas does not always exist, and the great may be considered as formed of two portions, applied, the one, on the side of the bodies of the vertebræ, the other, in front of the laminæ of the transverse processes. Separated from the quadratus muscle by the anterior layer of the aponeurosis of the transversalis, the psoas magnus is covered by a fibro-cellular membrane detached from the iliac fascia, and prolonged to the front of the process of the last dorsal vertebra, where it assumes the character of ligament. We there, in fact, find two fibrous arches, of which one, binding down the origin of the muscle, gives insertion to some fibres of the diaphragm; whilst the other extends from the vertebral process to the inferior margin and summit of the last rib, to form the *ligamentum arcuatum*. Between this ligament and the ribs, there is a small space filled by cellular tissue, through which the sub-pleural layers communicate with the cellular tissue of the flank. The other arch allows the tissues covering the spine in the chest and abdomen to unite, and transmit their diseases. Inferiorly, the psoæ separate from the fifth vertebra,

and run to limit internally the iliac fossa, where we shall again see them. As they act principally on the thighs, pain is frequently felt in the lumbar region as a consequence of over walking. To the right side the psoas is covered by the vena cava, to the left the aorta does not advance so far; its internal border is accompanied by the great sympathetic of both sides. When the psoas parvus exists, it lies in front of the other, and is only remarkable from its tendon, and that merely in the iliac fossa.

The *kidney*, placed in front of the two last ribs and quadratus lumborum, external to the psoas muscle, covered by the colon and peritoneum, is one of the most deep-seated organs of the abdomen. Instruments can only reach its anterior surface, after having traversed the liver, spleen, or colon, and two folds of the peritoneum; but it may be reached, posteriorly, without piercing the serous membrane, by traversing one of the two last intercostal spaces, at three or four inches external to the median line, or rather by penetrating the flank. On this occasion we should remark, that the kidney descends lower, and is closer to the spine, on the right than on the left. It is prolonged on each side to about two inches below the twelfth rib, and overlaps the quadratus muscle, so as to repose more or less immediately upon the aponeurosis of the transversalis. Its convex border is, therefore, the most superficial, the most exposed to injury, and encloses the smallest vessels.

The position and attachment of the kidney are subject to numerous anomalies. I have seen it in the iliac fossa on one side, and on the sacro-iliac symphysis on the other. In another subject it was, as it were, floating in the pelvis. I have frequently found them united in front of the spine. In a patient shown to me by Rayer, and in a female under my care at the Hôpital de la Charité, the right kidney might be pushed, under the form of a moveable tumour, as far as the umbilicus. We can understand, what mistakes these varieties may lead to, in the diagnosis of diseases and tumours of the abdomen.

The structure of this organ is remarkable for the size of its veins and arteries. However, phlegmonous inflammations are by no means common, resulting, no doubt, from the small quantity of cellular tissue entering into its composition. Of a dense and compact structure, it is enveloped in a fibrous membrane, preventing its swelling. Nevertheless, we, not unfrequently, find it acquiring enormous size, in some diseases, as yet but little understood, but on which the researches of M. Rayer appear to me likely to throw some light. When it enlarges, it is nearly always at the expense of the substance of its walls, and the calices generally merge into the pelvis; in which case it rapidly becomes a mere pouch, which diminishes in thickness as it dilates; a condition occasionally met with in *diabetes*.

Under these circumstances, the kidney may inflame, and its interior be converted into abscess, capable of bursting through the flank. I have, more than once, seen abscess discharge thus, and calculi escape through the opening: whence the idea of *nephrotomy*. But even if it be true, that this operation is not so difficult as is generally supposed, it is equally true, that it is almost inapplicable; for, on the one hand, we rarely have any certain indications of the disease, and, on the other, even if we succeeded in penetrating to the organ, as we should then only remove the effect of disease and not the disease itself, what benefit would be derived?

The fissure of the kidney encloses the *artery*, *vein*, and *ureter*, so disposed that the artery situated in the middle is more elevated, whilst the ureter, posteriorly, is more inferior. The right vein is much shorter than the left, from its proximity to the vena cava, to which it runs. It is the reverse with the artery, which is sometimes double, treble, and even quadruple, although there be only one kidney on each side. This disposition would be favourable in tying the aorta, if by chance the ligature were placed between the origins of these branches.

The *ureter*, conveying the urine from the kidney to the bladder, descends parallel to the vertebral column, in front of the psoas, enveloped in a sheath derived from the fascia propria. Its walls are very strong, without being thick. Its calibre has been observed to equal that of the small intestine, in cases where an obstacle had completely prevented the passage of urine into the bladder. It may, under these circumstances, burst, giving rise to fatal effusion, either into the peritoneum or in the fascia propria. Occasionally it is double; sometimes merely bifurcated.

The *cellular tissue*, filling the intervals of the various organs just described, forms, in an especial manner, a very thick layer around the kidney; most commonly the situation of deep-seated inflammation of the lumbar fossæ. Its lamellous disposition, abundance, and the nature of the parts embedded in it, favour, more than any other cause, the formation of abscess. Continuous with the cellular tissue in front of the spine, and, consequently, with the general layer of the abdomen and chest, fluids may collect here from various points. On the contrary, when abscesses occur here, the pus may burrow into the iliac fossa, or, passing beneath the integuments of the loins, produce symptoms of lumbar abscess. In 1825, I examined a body in which there was a communication between the chest, in front of the twelfth rib, and several other points on the lateral and posterior portion of the abdomen, produced by pus burrowing from the iliac fossa to the posterior mediastinum, and the whole of the right side of the chest. Hence, pus, from renal abscess, may spread into the meso-colon and mesentery, descend into the pelvis, or ascend to

the chest, flow into the iliac fossa, run into the crural or inguinal canal;—if it remains between the peritoneum and muscles, burrow beneath the fascia iliaca, follow the course of the iliacus and psoas muscles, spread, posteriorly, above the ilio-lumbar ligament, or beneath the last rib, collect beneath the skin of the loins, flanks, or posterior of the pelvis, and extend into the iliac region. In 1829, I found all these peculiarities in the same subject. The first abscess had burst into the ureters, the second spread to the loins, at first downwards, next upwards, afterwards to the flank, and, subsequently, to the sacrum. Effusion iliac into the chest brought on pleurisy and death. The mesentery, fossa, and true pelvis, were equally infiltrated with pus and urine.

The ureter may give rise to similar mischief, and the results of its perforations, spreading to a distance, give rise to urinary fistulæ of the perineum, towards the anus, or in the lumbar region.

Iliac fossa.—This fossa, limited, superiorly, by the crest of the ilium, where it presents a small fissure, augmenting its depth posteriorly, inferiorly by the posterior border of Poupart's ligament, and, internally, by the internal margin of the psoas muscle, triangular in shape, is inclined upwards, backwards, and inwards. In its two external thirds, it presents a species of groove, deeper in women than men, and gradually contracting as it terminates by a cul-de-sac, between the spine of the ilium and iliac artery. Internally, it offers a prominence, at first very large, diminishing towards the crural arch, where it limits the groove just described. On its internal side, we remark another depression, circumscribed, in front, by Poupart's ligament, behind by the ilio-pectineal crest, externally by the external iliac and epigastric arteries, internally by the origin of the umbilical ligament; and which, situated beneath the lesser inguinal fossa, corresponds to the superior opening of the crural canal; as the preceding, placed external to the epigastric artery, beneath the external inguinal fossa, corresponds to the posterior opening of the inguinal canal. The prominence, moreover, divides the iliac fossa from the pelvis, and bounds its abdominal margin.

The *peritoneum*, very elastic, easily separated from the parts it invests, appears thicker here than in other regions, from the cellular layer investing it, occasionally, assuming a fibrous character. Adherent only as it approaches the iliac crest, it is thus predisposed to form coverings for the viscera, when they constitute herniæ.

Fascia propria.—Beneath the peritoneum, we constantly find a considerable quantity of lamellous cellular tissue, the continuation of the general sub-peritoneal layer. Proceeding from the iliac fossa, it is easily traced above the crest of the ilium, between the serous membrane and the transversalis muscle; but it insensibly diminishes in thickness, and terminates by uniting with the fascia transversalis of the side of the loins, as it ascends to-

wards the kidnies. It is thicker and more elastic, as far as the posterior surface of Poupart's ligament, between the spine of the ilium and iliac vessels, where it is very distinct.

Passing over the anterior surface of the psoas, its laminæ divide, forming a sheath for the spermatic vessels. It next invests the ureter in a similar manner, and gives a complete sheath to the iliac vessels. Arriving at the inguinal fossæ, it envelopes the origin of the anterior, circumflex, epigastric, and umbilical arteries, and the vas deferens. In this situation it may easily be divided into two portions. One ascends, on the peritoneum, to the internal surface of the transversalis muscle; the other, thinner, invests the internal crural fossa, is prolonged into the crural canal, and becomes lost in the superficial fascia of the thigh. Spreading over the posterior surface of Gimbernat's and Poupart's ligaments, it appears to be continuous, above this latter, with the fascia transversalis, after having closed the entrance of the crural canal by a kind of diaphragm, described by J. Cloquet as the *septum crurale*.

The abundance and extreme elasticity of the cellular tissue explain how we may reach, not only the external, but even the common iliac, as performed by Mott, Crampton, Gibson, and, on the hypogastric, by Stevens and Atkinson, without cutting through the peritoneum. We also see, from the same reason, that the separation is much more easily effected as we approach Poupart's ligament and its neighbourhood, and that, in ascending, we should keep as close as possible to the line traced by the anterior border of the ilium. It was upon this ground that Baudelocque, Physick, and Ritgén recommended an incision of the same nature, to reach the summit of the uterus, or superior portion of the vagina, in the delivery of distorted females. Nothing is more easy than thus to push the peritoneum towards the pelvis; but the anatomical arrangement admitting it, in its turn, renders these operations exceedingly dangerous, as the inflammation resulting, almost inevitably produces most profuse deep-seated suppuration.* Finally, the projection produced by the psoas, and the continual re-action of the viscera, force the sub-peritoneal suppuration of the iliac fossa to point above Poupart's ligament, or in the crural canal. The depositions resulting from labour are similarly situated, because the cellular tissue of the round ligament, in which it frequently commences, is, in reality, merely a dependence of the preceding. Whether we meet with them in the recently delivered, in women affected with cancer, or who have disease of the uterus, or even among

* This does not always occur, as in the case in which Mr. Guthrie tied the common iliac, pursuing exactly the same method of separating the peritoneum from the iliac fossa, the succeeding inflammation and consequent suppuration were by no means excessive. Although the pus discharged from the wound was good, thick, healthy pus, it never flowed in sufficient quantity to endanger the life of the patient, or to lead to any great anxiety on that account. I can speak to this fact with certainty, having attended the patient throughout.—H. H.

men, in consequence of injury or disease of the intestines, these deposits are commonly situated in the fascia propria, and should be carefully distinguished from sub-aponeurotic abscess of the same region. A collection of this nature, filling the whole of the left flank, in a female, whom I saw with M. Fizeau, had forced the intestines so much over to the right, as to have formed a large tumour on that side.

Fascia iliaca.—The very thin layer, which has already been described, as given off from the ligamentum arcuatum, and from the fibrous arch embracing the origin of the psoæ, to spread in front of these muscles, insensibly thickens, as it descends towards the iliac fossa.

Splitting near the crest of the ilium, to envelope the anterior circumflex artery, it is continuous, at that point, with the fascia transversalis. Its thickness, diminishing over the fleshy portion, increases on the tendon of the psoas. Binding down the psoæ muscles, it becomes attached, at the margin of the pelvis, between them and the vessels, previous to continuing with the pelvic fascia. Inferiorly, the fascia iliaca again thickens, and ascends slightly in its external half, becoming attached to Poupart's ligament, subsequently, to the iliac spine, at about eight lines external to the crural artery, and to the pectineal crest, in its course to the spine of the pubes. It, sometimes, gives off a lamina, which is attached to the anterior surface of the femoral vessels.

Poupart's ligament thus appears to give origin to two membranes, of which one, the fascia transversalis, ascends on the posterior surface of the internal oblique and transversalis, whilst the other descends over the iliac fossa, constituting the fascia iliaca. In a word, the iliac and transverse fasciæ appear to form a large funnel, having its internal half elevated, and the opening in the groin represented by the crural canal.

Crural canal.—When the contents of this canal are carefully removed, we perceive that its *superior opening*, formed, anteriorly, by the slightly concave margin of Poupart's ligament, is limited, posteriorly, by the iliac aponeurosis or deep layer of the fascia lata. This latter half of its circumference is much more concave than the former. Externally, the orifice in question terminates by an acute angle, resulting from the bifurcation of the ligament.

Internally, it is bounded by the concave border of Gimbernat's ligament. Continuous, by its anterior edge, with the inferior margin of the external pillar of the inguinal ring, attached, by its posterior border, to the pectineal crest, and presenting, at its base, the concave margin already described, this ligament corresponds, by its apex, to the spine of the pubes, whilst its base serves as the internal limit to the opening of the crural canal. It is, sometimes, continuous with the two portions of the fascia lata, having its superior surface inclining downwards and out-

wards, so as to form a groove, which then completes the iliac fossa, a species of funnel, presented, naturally, by the crural canal.

Measured transversely, this opening possesses a diameter of nearly two inches, and, frequently, of two inches and a half in the female. From before backwards, in its greatest space, it is only from ten lines to an inch, and immediately contracts as it proceeds from the centre. In the natural state, it is divided into two portions, by the crural vessels, in such a manner that, from the iliac fossa, we arrive here by two small spaces, which I shall call the *crural fossettes*, one *internal*, the other *external*, and which must not be confounded with the *inguinal fossettes*, already mentioned. The *internal portion*, the largest, forms what is specially described as the *crural ring*; its limits are, internally, the concave and sharp border of Gimbernat's ligament, anteriorly, Poupart's ligament, posteriorly, the ilio-pectineal crest, and, externally, the crural artery and vein, and the epigastric artery. It ordinarily encloses a lymphatic gland, separated from the vessels by a kind of septum, a prolongation of the fascia propria, and some fat, which almost completely closes it. The viscera in crural hernia escape through this opening.

Its external portion is also triangular, and circumscribed, anteriorly by Poupart's ligament, posteriorly, by the fascia iliaca, where it passes to the thigh, becoming continuous with the fascia lata, externally, by the angle uniting the iliac fascia to the crural ligament, and internally, by the septum separating the femoral and epigastric arteries from the crural lymphatic gland.

In describing the crural ring, most anatomists have neglected this portion, for that internal to the vessels, which, in fact, offers much less interest; however, unless it be demonstrated that herniæ never occur there, Scarpa has gone too far, in advancing that the thing is impossible. In the dead body, I have always seen that the point of a finger, carried through the *external crural fossette*, penetrates, without much difficulty, into the crural canal, external to the artery. M. J. Cloquet, moreover, cites an example of this, in his dissertation.

Muscles.—The *psoas parvus* merely presents its tendon here. The *psoas magnus*, passing from the sides of the sacro-vertebral angle to the crural arch, contracts the transverse diameter of the superior opening of the pelvis; hence, the custom of slightly bending the thighs and legs during labour.

Attached to the whole of the fossa of the same name, the *iliacus muscle*, thin superiorly, thickens, in a remarkable manner, inferiorly, before it passes the crural arch.

Iliac canal, very large in the centre, the canal constituted by the fascia iliaca in front, and of which the ilium forms the floor, contracts inferiorly, to communicate with the thigh.

Its *femoral opening* is constituted, on one side, by the anterior border of the os innominatum, from the anterior superior spine,

as far as the ilio-pectineal eminence; and, on the other, by the external half of Poupart's ligament. Elliptic, and like the crural ring, which it resembles in more than one respect, and from which it is separated by merely that portion of the fascia iliaca descending from Poupart's ligament to the body of the pubes, this opening is completely filled by the psoas and iliacus muscles, the inguino-cutaneous and crural nerves.

The superior opening of the iliac canal is much less regular than the preceding. Posteriorly, it is limited by the ilio-lumbar ligament, the transverse process and side of the body of the last lumbar vertebra. Therefore, to avoid tearing the aponeurosis, we must carry the finger between the quadratus lumborum, the psoas, and the posterior cavity of the iliac crest.

The muscles confined in this canal may, consequently, contract, without interfering with the digestive organs, situated in front. We also perceive, how the fibrous sheaths, covering the psoas, unite the fascia iliaca to the ligamentum arcuatum of the diaphragm, forming a continuous tract from the latter, as far as the small trochanter.

This disposition explains the distinction necessary to be made when we treat of symptomatic abscess. It is well known, that pus from the abdomen frequently arrives at the groin, but the manner by which it does so remains to be studied. When it descends between the peritoneum and the fascia iliaca, it escapes by the crural or the inguinal canal, rather than by that which I have just described. As the result of deep-seated caries of the vertebræ, especially of those in the lumbar region, it more frequently burrows beneath the fascia iliaca, following the iliac canal. Thus, abscesses of the first kind depend, more particularly, upon inflammation of the subperitoneal cellular tissue, or of the soft parts in general, whilst those of the second coincide, nearly always, with caries of the spine.

These latter are, consequently, distinguished from abscesses of the iliac fossa, as they have no tendency to become superficial, or to reach the side of the pelvis, before spreading into the loins.

The opening conducting them to the thigh also allows the pus formed near the hip joint to enter the iliac fossa, and disorganize the muscles, filling it, as I saw in two instances, in 1831. Finally, it is of importance, that we should not confound under this point of view the diseases of the psoas muscle with those of the iliac, as is too generally done; in fact, the cellular membrane, which is prolonged upwards, is sufficiently thin for the former to reach the peritoneum, as well as the side of the ilium, whilst the latter are almost necessarily confined within the limits of the iliac canal.

Arteries.—Resulting from the bifurcation of the aorta, the *iliac arteries* arise opposite the cartilage, uniting the fourth and fifth lumbar vertebræ, sometimes a little higher, at others a little

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lower. Petsche has seen them separate from the aorta, close to the diaphragm. Their direction may be well shown, by a line drawn, from about two inches beneath the umbilicus, to the middle of Poupart's ligament; to the posterior border of the pubes, that of the left side is about four inches and a half long, whilst that of the right is five. To the middle of the crural ligament, they are each half an inch longer. The former, in leaving the sacro-vertebral angle, presents a very marked curve, having its convexity backwards, and slightly outwards, to beyond the sacro-iliac symphysis; subsequently a second, longer and much less marked, in an inverse direction, as far as its entrance beneath the crural arch.

After a course of two or three inches, the iliac arteries, in their turn, divide or bifurcate. Up to this point they bear the name of *common* or *primitive iliac*. Of the two branches resulting, one is the *internal iliac* or *pelvic*, the other the *external iliac* or *crural*. The precise point of their bifurcation is not regular. Most frequently, it is between the posterior pelvic symphysis and the sacro-vertebral eminence; sometimes, on the symphysis itself, and in other cases, on the bodies of the vertebræ. It is usually close to the spine on the right, whilst on the left it is less distant from the sacro-iliac articulation; not that they are more prolonged on one side than the other on this account, but, simply, because that of the right side has to pursue a longer course before it arrives in front of the symphysis. These variations as to origin, which appear indifferent at first sight, would, however, be very important, were it possible to recognize them during life, when we would apply a ligature on one of their trunks.

Between the common iliac and the crural arch, the *external iliac arteries* are enveloped in a very strong sheath, derived from the fascia propria. This sheath is thicker anteriorly than posteriorly, much stronger inferiorly than superiorly, and at the same time encloses the vein. Externally, each lies on the fascia iliaca, which separates it from the psoas muscles; posteriorly, we find its accompanying veins and obturator nerves. Anteriorly, it is covered by the peritoneum, and crossed by the ureters, opposite the symphysis, and by the vas deferens, near the crural arch. The genito-crural nerve, or one of its branches, frequently ramifies in front, or on its external side, and is, therefore, with difficulty avoided in the ligature of this vessel, which is, in addition, surrounded by a sheath and lymphatic glands. We must remark that the external iliac sometimes furnishes the profunda. In the patient in whom James tied the aorta, it was double, so that the thread might have been applied on the sound branch, and, consequently, have no influence over the aneurism.

Of all these relations, the most important are those existing between the artery and vein, and between the artery and the

sheath formed by the fascia propria; as, if we would tie the first, we must draw the second out of the way, and divide the last.

Before it furnishes the internal, the primitive iliac sometimes gives off the *ilio-lumbar*, which always dips down into the iliac fossa, when it anastomoses with the circumflexa ilii, and, a little higher, with the last lumbar branches. This would perform an important function, if the aorta were obliterated above its origin.

The *epigastric* commonly arises opposite the pectineal crest, from the anterior and internal portion of the external iliac artery. It is rarely given off from a trunk, common to it and to the circumflexa ilii, but it has been seen proceeding from the femoral, and even from the profunda. In the subject dissected by Michelet, it furnished the internal circumflex artery of the left thigh. Sometimes, also, its commencement is more elevated, at about an inch behind the pubes and the iliac fossa. The first case would render ligature of the crural artery more dangerous between Poupart's ligament and the origin of the profunda, but it would favour the same operation performed on the external iliac. The second would render the latter dangerous, and be favourable to the former. Beclard tied the external iliac, in 1822, at the Hôpital de la Faculté. The patient died of hemorrhage four days afterwards, and we found that the thread, placed about two lines beneath the epigastric, had cut through half the substance of the iliac artery.

Immediately after its origin, the epigastric artery descends obliquely within, to reascend behind Poupart's ligament, forming the fourth of a circle, embracing the inferior and internal portion of the spermatic cord. When the viscera escape through the internal crural fossette, half the external circumference of the tumour is surrounded by the iliac vein, the artery, and the origin of the epigastric vessels. The knife must, therefore, be directed towards its interior semicircle. The epigastric here gives off two branches, one which follows the posterior surface of Poupart's or Gimbernat's ligament to cross the symphysis; the other, seldom more than a branch of the latter, descends, crossing the posterior surface of the same ligament, to the subpubic foramen.

The first may follow the inferior border of the ligament, proceed parallel to its superior border, or even above it. Surrounding, in the first place, the inferior portion of the neck of the sac, it passes over its anterior half circumference in the second; a disposition which has alarmed surgeons, and has led them to cut inwards, instead of directing the bistouri vertically, or parallel to the linea alba.

When this branch does not furnish the *obturator*, it is rarely of sufficient size to endanger hemorrhage. Hey says that he wounded the epigastric, cutting upwards, and that the hemorrhage was stopped without difficulty, by means of small pieces of

sponge introduced into the wound. The patient being cured, he could not ascertain the precise nature of the injury; but, as Scarpa also remarks, the injured artery was not the epigastric, since that almost constantly lies externally in crural hernia. It is difficult to suppose, with this latter author, that it was the obturator arising from the femoral or epigastric; I think that it was merely the branch in question, which had attained more than ordinary magnitude. In fact, it is not to be presumed, that simple compression would entirely suspend a hemorrhage arising from either of the arteries mentioned by these two surgeons. The second as frequently arises from that which we have just described as from the epigastric itself. Running sometimes closer, sometimes further from it, it would, in one case, reach the subpubic foramen, by embracing the external part of the neck of the sac, whilst, in the other, it winds round the internal side, unless the branch furnishing it passes beneath the tumour. In this case, happily the most frequent, all the internal and superior half is without vessels, so that in women, where the spermatic artery causes no anxiety, we may cut with certainty on this side. In the former, on the contrary, the neck of the sac would be, almost completely, surrounded by arteries. With such a disposition, it would be impossible to avoid severe hemorrhage in operating for crural hernia, and the embarrassment would be much increased, if there existed a second epigastric, furnished by the internal iliac, of which M. Lauth communicated a case to me, and as I myself saw in 1832; for it is probable, that the anormal branch would be then placed within the tumour.

It is now a long time since anatomists remarked the common origin of the *epigastric* and *obturator* arteries, but it is later that Monro attempted to establish, in what proportion of cases this is met with. He says, one time in twenty; Burns announces more than thirty instances; Hesselbach considers this anomaly very rare. Scarpa and Lawrance admit, that it may take place once in ten or fifteen times; M. J. Cloquet, once in three or five; and F. Meckel, that it is almost as common as the normal condition. My own observation, founded on the examination of upwards of one thousand bodies, leads me to coincide with Monro.

Finally, it is easy to understand this common origin. The obturator artery, in fact, is naturally produced by two branches, of equal size, in the very young fœtus; one supplied by the hypogastric, the other by the external iliac or epigastric. After birth, and in the adult, one of these branches remains as it was during the early period of intra-uterine life, whilst the other alone follows the general increase of organization. Or if, contrary to the usual order, the branch from the internal iliac is arrested in its developement, the obturator will appear to come from the epigastric. It is, therefore, in some degree, a natural

disposition. It must be observed, moreover, that, in the majority of cases, the obturator artery, arising from the epigastric, is pushed outwards and backwards by the organs protruding to form femoral hernia, and that it would only pass above and internal to this tumour, in those subjects where the proper pubic branch gives it off, and would itself be separated from the epigastric, and considerably from the external iliac. In a double femoral hernia of one side, Burns saw the obturator descend between the neck of the two tumours; so that the division of the one might have been performed without danger internally, whilst that of the other would, almost of necessity, have been succeeded by hemorrhage.

If the obturator artery should wind round the superior side of the hernia, it does not follow, that it would inevitably be divided by cutting on the concave margin of Gimbernat's ligament. In crural hernia, this ligament is commonly very much inclined towards the thigh. On the other hand, the vessels, more or less prolonged, by the viscera, from the circumference of the ring, are naturally enveloped in the fascia propria, which retains them at a sufficient distance from the superior surface of the ligament, as, generally, to permit of our cutting sufficiently upwards or inwards, without interfering with the surrounding arteries. The danger, moreover, is less, as the obturator detaches itself from the epigastric higher up, or as the latter arises from the external iliac at a greater distance from Poupart's ligament.

When, on the contrary, they arise from the femoral together, that is to say, between the pectineal crest and the origin of the profunda, if the obturator does not pass between the tumour and the pectineus muscle, if it ascends on the anterior surface of the neck of the sac, we can imagine, that in the degree of its proximity to the situation of the stricture, so is its danger of being injured.

The epigastric, in its turn, may be only a branch of the obturator, or any other division of the internal iliac. This disposition has been noticed by Monro, and we also find another extraordinary example in the works of Hesselbach. Meckel, who accused the latter of being mistaken, had, doubtless, never seen the beautiful plates in which it is represented. In the instance for which I am indebted to M. Lauth, it proceeded from the bottom of the pelvis. In such a case, whatever kind of hernia it be, the epigastric would run along its internal side; but, probably, sufficiently far from the ring to escape being wounded, where the bistouri is properly directed.

Anterior iliac, or *circumflexa ilii*, also given off from the external iliac, previous to its entering the crural canal, arises, commonly, opposite the epigastric. Arrived close to the external angle of the crural canal, it pierces the iliac fascia, which splits, near its attachment at Poupart's ligament, to supply it with a

sheath. Following the curvature of the crest of the ilium, it gives off, from its concavity, several branches, which anastomose with the ilio-lumbar, whilst others arise, from its convexity, to ramify in the abdominal parietes.

The *spermatic artery*, arising from the aorta or renal artery, descends in the fascia propria, in front of the psoæ muscles, as far as the posterior surface of Poupart's ligament, without being of much interest, as regards surgery. By degrees it approaches the vas deferens, and ascends into the inguinal canal; it here becomes of importance, relative to crural hernia, in man. The spermatic cord, in fact, is so disposed, that in entering the canal it lies external to crural hernia, whilst in leaving the external ring it is internal. Crossing the whole of the superior surface of the tumour, it might be divided by an incision made directly upwards.

Arnaud, who says that he lost a patient by this incision, and mentions a similar accident as occurring to another surgeon, was so convinced that the hemorrhages, considered before his time as proceeding from the epigastric, depended upon the division of the spermatic, and of the impossibility of avoiding this vessel in cutting upwards, that he subsequently preferred opening the neck of the sac with a pair of scissars, and raising the crural arch with a hook, to employing a knife. Sir A. Cooper and Scarpa have partaken of these fears, and their opinions are at present usually adopted. The first of these authors has, certainly, magnified the dangers of cutting otherwise than he recommends; but Gunz is also wrong, when, in opposition to Arnaud, he maintains that the spermatic artery cannot be wounded, unless we completely divide Poupart's ligament.

This ligament is hollowed into a groove, at the bottom of which the artery runs obliquely, thus approximating rather closer to the neck of the hernia than might, at first sight, be supposed; but, as this trench is effaced as the external pillar of the ring approaches the spine of the pubes, we can only reach the cord at its internal portion, after cutting to a greater extent than is usually required. We should also observe, that, being loosely enveloped in the inguinal canal, it rolls under the knife before it is divided, and that the spermatic artery itself is generally too small to give rise to any serious hemorrhage.

Besides the epigastric and circumflex, the external iliac sometimes, though rarely, gives off a *renal*. I met with this once, in 1825, and again in 1829. They were on the right side in both cases. This would be an unfortunate arrangement, where the trunk of the external iliac required to be tied high up. The external iliac has been too frequently and too successfully tied to admit of question as to its utility. The circulation is then continued, without difficulty, by the numerous anastomoses existing between the cutaneous, the circumflex, epigastric branches, and the intercostal lumbar, ilio-lumbar, and internal mammary

arteries, between the circumflex and all the superior branches of the femoral, the gluteal, sciatic, internal, pubic, obturator, &c. arteries.

Veins.—Running to the vena cava, on the side of the four or five lumbar vertebræ, the *primitive iliac* veins contract relations with their accompanying arteries, which are not the same on both sides. To understand this distinction, it will be quite sufficient to bear in mind what has already been said, with regard to the artery of the right side, and the vein of the left, and reciprocally. Hence it results, that the latter has to cross the posterior surface of the commencement of the right iliac, and, also, the aorta, to reach the internal side of the left iliac, so that the external side of the latter is free, through its whole extent. On the right, on the contrary, the vein, at first situated external to its artery, runs by degrees beneath its posterior surface, finally lying to its inner side before reaching the internal ring. Thus, we may easily pass a ligature around the artery of the right side, by sliding the smooth extremity of an aneurismal needle or director, on its pelvic side, obliquely outwards. This method would be equally applicable on the left side, at whatever height the operation is required, even if it be upon the common iliac itself.

The *ilio-lumbar* and *circumflex* always follow the arteries of the same name. The two veins accompanying each *epigastric* artery do so likewise; with this difference, however, that they do not form the curve beneath the cords, as they empty themselves into the external iliac, which corresponds to the middle portion of the abdominal orifice of the inguinal canal. The epigastric artery would, consequently, be secured with greater facility near its commencement.

The *spermatic veins* also follow their arteries, which, however, they greatly surpass in size. There are always two, occasionally three, especially in the female, where these vessels are termed ovarian, sometimes representing a complete plexus, between the kidney and round ligament. In this sex, and occasionally also in man, the lumbar veins anastomose with the branches of the circumflex and ilio-lumbar, constituting in and above the iliac fossa another *plexus*, named *pampiniform*, which, however, must not be confounded with the preceding. The length of the ovarian and spermatic veins, the thinness of their walls, and the softness of the parts through which they run, predispose them to the varicose dilatation, occasionally manifested, and permit of their bursting; producing fatal hemorrhage in the abdomen.

The *lymphatics* of the iliac fossa are very abundant. These vessels are large, short, and numerous. The glands forming a chain around the blood vessels are all placed in the fascia propria. Their tumours may resemble aneurism. That situated in the crural ring, ordinarily much elongated, may project into

the pelvis, and, at the same time, extend as far as the external opening of the crural, which it sometimes almost entirely fills. We can understand that, contained in a narrow space, if it should swell, serious mischief would result; that it might, for example, compress the femoral artery and vein, or form a tumour in the groin, resembling hernia. In a patient sent to me by M. Chardel, it constituted a band of union between two enormous encephaloid tumours, one of which occupied the iliac fossa, and the other the groin.

The *nerves* derived from the lumbar plexus, at first enveloped by the fibres of the psoas muscle, ramify beneath the aponeurosis, before piercing it.

The *inguino-cutaneous*, oblique as far as the anterior superior spine of the ilium, traverses the notch separating this process from the anterior inferior spine, and does not perforate the aponeurosis until it reaches the thigh.

The *genito-crural* runs parallel to the iliac artery, almost always on its outer side, and occasionally on its anterior surface. In the latter case, it is better to catch it with a pair of forceps, and cut it across, instead of implicating it in the ligature of the vessel. If, however, it has already been pressed by the thread, we should then confine ourselves, to drawing the ligature tighter, so as completely to destroy its action. Its two branches generally divide close to Poupart's ligament. The inguinal soon unites to the spermatic vessels and vas deferens, entering the inguinal canal with them. The femoral follows the original direction of the nerve, and runs to the external portion of the crural canal; but they are neither of them sufficiently large to lead to much practical consideration.

The *obturator* descends beneath the internal side of the psoas muscle, and pierces the aponeurosis covering the sacro-iliac symphysis, to traverse the pelvis, where it remains behind the iliac vessels. We shall again meet with it in the pelvic cavity, as also with the lumbo-sacral nerve, uniting in front of the sacrum the two plexuses, whence its name is derived.

The *crural* is here an essential nerve. As it descends, it by degrees leaves the posterior surface of the psoas, so that towards the inferior third of the iliac fossa, it lies beneath the iliac fascia, in the fissure uniting the two fleshy masses of the region. Separated from the artery up to this point, by the thickness of the muscle beneath which it lies, it subsequently approaches it so closely, that at its entrance into the crural canal, they are merely divided by the aponeurosis. Enclosed in the same fibrous canal with the iliac and psoas muscles, it runs with them beneath the crural arch by the iliac canal, of which it fills the internal angle, and may be considerably pressed upon by the head of the child during labour.

The *skeleton*, formed by the osseous portion, whence the name of the region is derived, does not, properly, comprehend

the ilium, which we will examine more particularly with the gluteal region. We shall, therefore, merely remark, that the two iliac fossæ nearly completely form that which is called the *greater basin* or *pelvis*, the greater dimensions of which, in the female, depend upon increased separation of the iliac spine. As the inguinal canal is at the same time very small, femoral herniæ are just as common among women as inguinal among men. Thus, in infancy, where nothing of the kind exists, inguinal herniæ are almost as frequent as crural among young girls.

The crest of the ilium is occasionally thrown backwards, or towards the side, so that the whole of the bone approaches the horizontal direction, and the iliac fossa becomes flattened. This disposition, which singularly favours the inclination of the uterus during pregnancy, if it should occur in females sufficiently young to become *enceinte*, appears to me to depend upon the gentle, but permanent, pressure, exercised by the viscera upon the bones, badly supported by the abdominal parietes, relaxed partly by age, or in consequence of repeated pregnancies, dropsy, or even from the ordinary en-bon-point towards the close of life. When, on the contrary, in adult females, the iliac crests are too much elevated, that is to say, when they are disposed as in man, they favour the descent of the uterus during labour.

The iliac muscle is so loosely attached to the fossa, that in inflammations the latter is quickly denuded by suppuration. Hence the extreme tendency of the ilium to necrosis, &c. in consequence of psoas abscess, &c., and the necessity of active treatment at the commencement of these diseases.

SECTION SECOND.

VISCERA.

We will now briefly examine the various organs enclosed in the cavity of the abdomen.

The *liver* fills the whole of the right hypochondrium. Its left lobe extends also into the epigastrium, where it may be easily felt through the walls of the abdomen in thin persons, or when swollen. In the living subject, it ascends and descends slightly during respiration. Thus, when we examine it externally, we should desire the patient to take a deep inspiration. In the fœtus, and during infancy, it extends more or less beyond the false ribs; in the adult, on the contrary, and in sound health, it is completely sheltered by these bones, excepting in its epigastric portion. However, it has been occasionally found so much elongated and relaxed, that it descended into the iliac region, and even into an inguinal hernia.

On the dead body, in a horizontal position, the liver sometimes ascends an inch or two; in the vertical position it descends beyond the margin of the ribs. During life, it is much less mobile. Its convex surface, overlaid, as it were, by the diaphragm, and invested by the peritoneum, is much predisposed to the contraction of adhesions. We can understand, then, that abscesses of the liver may project through the last intercostal spaces, or beneath the ribs, in the lumbar regions and flank; or into the epigastrium, and open externally. From the relative position of its concave surface, these abscesses may open into the transverse colon, and discharge through it when they occur in its anterior margin; or into the stomach, and be thus evacuated by vomiting, as well as in the first portion of the duodenum.

Its slight extensibility, fragile texture, its size and weight, cause it to be very frequently ruptured, notwithstanding the protection afforded by the ribs, by shocks or external violence received on the abdomen, either directly or by concussion. The enlargements which it undergoes in some persons, during intermittent fevers, cause it to pass the hypochondrium and render this accident still more probable, as then a kick or blow from a stick is quite sufficient to cause rupture. I have seen this occur from the patient having been run over, although the external trace of injury was very slight. Its wounds are excessively dangerous, partly on account of the large and numerous vessels ramifying in it, and partly because they must of necessity be penetrating.

The *base of the gall bladder*, corresponding to the cartilage of the ninth rib, projects, when distended, beneath the right hypochondrium. It would be excessively dangerous to mistake such a tumour for an abscess. As in this condition it inflames, contracting firm adhesions with the abdominal parietes, its opening is not always followed by effusions into the abdomen. Hence J. L. Petit recommended the extraction of biliary calculi by making an opening in the hypochondrium. Surrounding the hepatic ducts there are some glands, which in swelling may obstruct the passage of the bile into the duodenum, and cause a general *icterus*, or at least considerable distension of the gall bladder, when the pressure takes place upon the ductus cholidicus, which may open into the vena porta; producing phlebitis, quickly fatal.

The relation of the gall bladder with the transverse colon allows of its contracting adhesions with that intestine, and accounts for the calculi being expelled through it. Liable to concussion from the other viscera, closed by the folding of its neck, it is so much compressed, in most of the violent blows on the abdomen, as easily to be ruptured. Its ducts, especially the hepatic, allowing but little distension, may yield from the same causes, as in the case related by M. Cam-

paignac; and the bile contained in the organ flowing into the peritoneum is the principal danger of such injuries. However, as it is the continued flow of bile, rather than the primitive effusion, which produces death, by generalizing the inflammation, we may imagine, with M. Campaignac, that by applying a ligature on the cystic duct, (which appears to me to be extremely dangerous,) or round the wound, when it occupies the base or inferior surface of the organ, it would not be absolutely impossible to arrest the progress of the evil. Being, moreover, free at its two inferior thirds, it might be possible to apply actual cautery to the wound, as performed upon some animals by M. Vilardebo, and thus prevent the necessity of leaving a thread in the abdomen. But the existence and seat of such injuries appear to me so difficult to be precisely ascertained, that these methods can scarcely be available. The most elevated portion of its base is sufficiently close to the hypochondrium to render its perforation, or that of its superior wall, across the substance of the liver, capable of being succeeded by an external fistula without destroying the patient. The case of the old soldier, mentioned by M. Civiale, appears to belong to this class. From the same disposition the incision as recommended by M. Greves, or M. Begin, would allow the distended organ to enter the wound, and there be opened without much danger. Finally, the two cases published by M. Chaule prove that the operation introduced by Petit should be retained.

The *spleen*, in the natural condition, is nearly completely enclosed in the left hypochondrium. Its convex and smooth surface corresponds to the three last intercostal spaces, and extends a little beyond the last rib. Posteriorly, it is separated from the diaphragm above, and the kidney below, merely by peritoneum. Being covered in front by the stomach, violent exercise immediately after eating causes great pain in the left side. Essentially composed of vessels, this organ is more than any other predisposed to swell, being capable of acquiring enormous size, notwithstanding it is enveloped in a fibrous membrane. It has been found weighing thirty-five pounds, and I have myself seen it filling the left half of the abdomen, descending into the iliac fossa.

Like the liver, its texture renders it very susceptible of being ruptured. Its functions are but little understood, and appear of so little importance that it has been removed more than once. M. Powel performed the operation on a patient, who perfectly recovered; Bailleau relates another example. Its injuries are only dangerous from the succeeding hemorrhage.

The *stomach*, partly filling the left hypochondrium, and a large portion of the epigastrium, is by no means fixed in its situation. In the adult, its superior margin is very much curved, whilst in the fœtus it descends almost perpendicularly

towards the umbilicus. When full, its anterior surface in contact with the inferior portion of the liver, and particularly with the left lobe of that organ, explains why reclining and sleeping on the left side are painful immediately after meals, and how, if it be ulcerated or destroyed in that direction, it may to a certain degree continue its functions, without allowing the food to pass into the cavity of the peritoneum. Its mobility accounts for its occasional presence in umbilical, and even inguinal hernia.

Confined, as it were, in the hypochondrium, after digestion, the stomach is then less exposed to the action of external bodies, and we may traverse the epigastric region, from one side to the other, with a sword for instance, without injury; of which I had proof at the Hôpital de la Faculté, in 1835. A man had been run through the abdomen by a sword. Entering at three inches external to and above the umbilicus, on the left side, it made its exit on the right, between the ninth and tenth rib, having left the stomach and transverse colon below and to the left, without touching them. Next grazing the inferior surface of the liver, it had entered that organ above the gall bladder, after piercing the small omentum.

The greater curvature of the stomach, embraced by the gastro-epiploic artery, allows pulsation to be felt in some positions, and among thin individuals, resembling aneurism, and rendering wounds more dangerous here, in consequence of the hemorrhage. Its lesser curvature, also traversed by two arteries, the coronary and pyloric, can be but rarely injured. With regard to wounds of its anterior surface, they are more frequent and less dangerous, as there are fewer vessels, and it is easier to apply the suture.

Besides being very mobile and elastic, the stomach is so disposed, when distended, that the curve which it represents with the cardia and duodenum, prevents ejection of the contents from simple pressure of the walls. Consequently, in this condition, a fall or blow on the abdomen will be sufficient to rupture it. From its proximity to the abdominal parietes, ulcerations or wounds of its anterior surface are sometimes preceded or followed by adhesion above the umbilicus. Hence those perforations of the epigastrium, recommended for conveying food directly into the stomach. It is thus, that foreign substances, a knife, metal, &c. swallowed, have shown themselves in the same region. Ulceration of the greater curvature would, for the same reason, permit fluids to burrow between the folds of the omentum, and thus to present themselves externally as abscesses, of which Le Dran has related an example. The depending position of its great cul-de-sac, causes fluids, &c. to stagnate during disease and after death, in some measure explaining the frequency of its ramolissement, and large perforation, not only in the young person, but the adult, as I saw

in 1827, with M. Carpuron, in a medical student. Its relations with the diaphragm on the other hand, are the causes of its frequent passage into the thorax, when this muscle is perforated; then allowing it to ascend even as far as the clavicle, or, at least, very high up beneath the ribs, interfering in the diagnosis of the causes of disease of the chest. It is frequently so large in great eaters, or from disease, as to extend to the pubes, rendering it very liable to be implicated in herniæ. Although the importance of the stomach is indisputable, its almost complete disorganization is not always an absolute obstacle to digestion. It has been met with transformed into a cartilaginous bag, more than half an inch thick. Its walls, in a woman whom I saw in 1831, were totally diseased by cancer, and were one or two inches thick in all parts, excepting in front, in a circle of two or three inches, although the digestive functions proceeded up to the moment of death. Its distension by food also shows, that wounds are more dangerous after than before meals. Although its termination in cul-de-sac does not appear compatible with life, we must admit, that the matters traversing it need not be ejected by the anus, if there was no imposition in the case of the beggar cited by M. Denis, who had no rectal opening, and from his birth had returned what he ate by the mouth. The same may be said of a subject mentioned by M. Montessanto, where the anus had been closed for ten years.

The *duodenum* is remarkable, in surgery, from its fixed position preventing its implication in herniæ, and from its relations with other organs. This stability is not always an obstacle to its being enclosed in the exomphali. M. Cruveilhier has seen it so free as to descend to the groin. Its superior portion is sufficiently near the concave surface of the liver, anteriorly and superiorly, to compress the excretory biliary ducts, or for hepatic abscesses to burst into its interior, and biliary calculi to be also received there. The second, lying on the kidney, may be perforated in abscess of that organ, so that renal calculi, and purulent or urinary collections, are also sometimes discharged through it. In front, it corresponds to the colon, crossing the commencement of the arch, and frequently being united to it by inflammations. Posteriorly, and to the left, it embraces the pancreas, the canal of which it covers, as well as the termination of the ductus choledochus, perforating its posterior wall. Thus, derangement of the biliary secretion is frequently dependent upon its disorganization. Its third portion, placed transversely, in front of the spine, in the separation of the layers of the transverse mesocolon, is so disposed, that it lies upon the inferior vena cava and the aorta, immediately beneath the superior mesenteric artery. The peritoneum being very loosely united in front, it may dilate considerably, and, consequently, raise this last artery

sufficiently for its pulsation to be felt through the wall of the abdomen.

The *small intestine* extends obliquely, forming several convolutions, from the left side of the second lumbar vertebra to the right iliac fossa. As a whole, it represents a sort of moveable packet, occupying the whole of the umbilical region, a portion of the flanks, and the hypogastrium. Its weight tends to draw it towards the most depending parts, whilst the length and extensibility of its folds allow of its protrusion through all the natural or accidental openings of the abdomen; consequently, we find it in nearly all inguinal, crural, perineal, umbilical, ventral, &c. herniæ. Compressed by the action of the muscles, it promptly protrudes when an opening of any extent is made in the abdomen, and is thus liable to all kinds of injuries. Wounds are always dangerous, especially those near the duodenum; on the one hand, because, if it should become necessary to make an artificial anus, the food would then escape before nutritious particles had been absorbed; on the other, because, near the transverse mesocolon, the small intestine is so deeply situated, that it would be difficult to draw the wounded portion towards the exterior.

The mass formed by the small intestines, between the walls of the abdomen and the lumbar, or most prominent portion of the spine, partly furnishes the reason for their being torn and bruised, without any external solution of continuity; and why, when distended, a kick, blow, or violence of any kind, easily produces rupture. Their length, and the shortness of the mesentery, cause them to become implicated in various diseases, and to twist upon themselves to so great a degree, as to be constricted. As the vessels enter the concave border of this canal, wounds are much more dangerous there than at its convex portion, which is more easily brought in relation to the abdominal parietes. Composed of circular and longitudinal fibres, its wounds would always be succeeded by separation of parts, when they occurred parallel or transversely to its axis; were it not, happily, that the mucous membrane immediately swells, closing the wound, when not more than a few lines in extent; thus preventing effusion. This peculiarity shows the inutility of acupuncture in intestinal tympanites.

The serous investment adhering intimately to the muscular, this portion of the alimentary canal is scarcely susceptible of dilatation. From its cellular character, when once inflamed, this tunic would ulcerate, and break upon the least constriction; thus, nothing is more common in strangulated herniæ, than circular and concentric ulceration of the constricted intestine. Its predisposition to adhesive inflammation explains how the omentum adheres so quickly to it, and how it becomes everted, uniting with itself, external to a ligature comprehending either its whole cylinder, or the circumference of its lateral openings;

thereby enclosing the thread, and obliging it to fall into the interior of the intestine, carrying with it the constricted portion of the organ; and how the lips of its wounds are cemented so promptly to the neighbouring parts, re-establishing its continuity.

The fleshy membrane of the small intestine, composed of regularly interlacing fibres, offers considerable resistance to causes of distension. Its villous tunic encloses numerous small granules, described by Peyer and Bruner. Disseminated, on the one hand, over the whole extent of the membrane, and, on the other, assembled in oval, round, or irregular patches, especially towards the cœcum, these, when attacked by specific inflammation, produce a great majority of the fevers, called putrid, adynamic, ataxic, typhoid, &c. They are, also, the seat of those ulcerations so frequently met with in the last stage of phthisis.

The fungoid texture of this tunic, allowing only its free surface to swell, also interrupts the passage of food, after herniæ with gangrene, where the constriction has not been removed to a sufficient extent. Softer, and as easily inflamed as the peritoneum, the internal tunics of the intestine, as has long since been observed by Dupuytren, are mostly the first to yield when strangulated.

In the adult, the cœcum almost completely fills the right iliac fossa. Its appendix, which floats in the true pelvis, is capable of uniting, by its apex, to other organs, forming a ring, in which the small intestines may enter, occasionally becoming constricted. Larger than the rest of the intestine, succeeding to the narrowest portion of the ilium, and forming a cul-de-sac, it allows of the contents accumulating and becoming hard to a much greater extent than elsewhere; so much so, in fact, that the swelling resulting has often been mistaken for a diseased mass, and treated as such. It may compress the surrounding tissues, and produce inflammation. Hence, doubtless, one of the causes of abscess in the right iliac fossa, especially of those preceded by constipation, or intestinal inflammation. Foreign substances, such as cherry and grape stones, &c. easily enter here, thus producing inflammation and considerable danger. Its anterior saculi explain its tendency to become cemented to the parietes of the iliac fossa, and how its perforation might produce subcutaneous gangrenous abscess in the supra-inguinal region, and, subsequently, a fistula, capable of immediate cure.

The manner in which the cœcum is fixed in the iliac fossa varies. When the peritoneum invests it, so as to form the *meso-cæcum*, posteriorly, it is very moveable, and may be displaced with the greatest facility.

When, on the contrary, the serous membrane only invests its anterior two thirds, it appears firmly fixed to the point which

it habitually occupies. In the former case it may extend towards the inguinal and crural canals, through the unravelled linea alba, umbilicus, perinæum, and even to the opposite side, forming herniæ, similar to those of the small intestines, as it is then completely enveloped in peritoneum. In the second, it may also, although less easily, escape through the parts already indicated. Here, the portion invested merely by cellular tissue may be in contact with the external investments, and, by chance, be drawn into the inguinal canal, without possessing any proper hernial sac.

Finally, the size of the cœcum, its attachment, the support it derives from the iliac crest externally, and the vertebral column, or psoas muscle, internally, its proximity to the abdominal parietes, and the ilium, which supports it posteriorly, render it, of all the intestines, one of the most subject to rupture.

The *ascending colon* mounts as far as the supra-umbilical line, before it curves to the left, to form the transverse colon. Smaller than the cœcum, like it sacculated, and of a much greater calibre than the small intestines, it is sometimes fixed in front of the quadratus lumborum, or kidney, by a true *mesocolon*, and sometimes deprived of peritoneum in its posterior fifth; whence it follows, that lumbar abscesses and nephritic calculi may enter this intestine, and that, reciprocally, an opening of the colon may be succeeded by a stercoraceous deposit in the lumbar region; thus producing true intestinal fistula. The cœcum may do as much on its anterior half.

Whilst on this subject, we may remark that the presence of pins, shot, &c. in the bladder of man, forming nuclei for calculi, is by no means an extraordinary occurrence. The natural relation between the colon and ureter, in fact, perfectly accounts for this, and I have no doubt that some of the most surprising facts related, depend upon this arrangement. I saw a remarkable example in 1831. A pin, the head of which still remained in the colon, which was greatly ulcerated, entered the ureter by its point, in such a manner, that the calculus, of which it formed the centre, existed partly within, and partly external to this canal. The continuity of the cellular tissue of its posterior border with that of the pelvic fossa shows how these ulcerations may produce swelling and disease of the sub-peritoneal layer, from the kidney to the summit of the pelvis, as occurred in the individual whose case I have just described.

Anteriorly, the colon presents a certain number of fatty appendices, which, becoming very large and long, may enter into herniæ. It must, on the other hand, be said, that these appendices, when met with in an hernial sac, are quite sufficient indication, that the tumour contains a portion of large intestine. Finally, when the right colon has been destroyed by gangrene, or cut

across, the flaccidity of its walls, its dimensions, and the little aptitude of its fibres to contract, admit of invagination being easily attempted, or any kind of sutures applied. Its villous tunic encloses Peyer's or Brumer's glands, like that of the small intestine; but with this remarkable difference, that they are larger and more disseminated, without being collected into a single patch.

The *transverse colon*, or *arch of the colon*, is merely the preceding intestine changed in direction. The length of its mesocolon allows it to extend into the pelvis. It may also ascend, entering the thoracic cavity, if the diaphragm be perforated or torn. Attached to the inferior margin of the stomach, or at least to the great omentum, it follows all their changes of position. Its proximity to the gall bladder, and the concave surface of the liver, is sufficient on the right side to permit of its contracting adherences with those organs in inflammation. When distended by gas, its uneven surface may be distinguished externally. Its relations with the omenta, and the length of its mesenteric fold, render it of all the large intestines the most liable to be implicated in umbilical hernia. It has also been seen in crural, inguinal, perinæal, and epigastric herniæ. Being in contact with the anterior wall of the abdomen, it may become cemented to it when ulcerated. Stercoraceous fistulæ in the upper part of the umbilical region may result from its perforation; and abscesses in the peritoneal cellular tissue might open into it were adherence well established.

The *descending colon* appears much more deeply seated than the right; at first, because it is of less calibre; subsequently, because it is seated further in the hypochondrium; and, finally, because the peritoneum but rarely forms a distinct fold of sufficient length to fix it in front of the lumbar region. It results, first, that vulnerant bodies less easily reach it; secondly, that it is rarely displaced or found in herniæ; thirdly, that it may easily be reached by the lumbar region, without opening the peritoneum, since it scarcely ever has any mesocolon, on the one hand, and, on the other, the kidney descends lower. It might be chosen by surgeons for the establishment of artificial anus, for another reason, that matter arrived at this point does not ordinarily enclose nutritious particles. Inferiorly, the left colon is curved on the iliac fossa in the form of an *S*. It again becomes mobile, and has most of the characters of the transverse colon, whence it follows, that it is frequently implicated in corresponding crural and inguinal openings, and that it may as easily extend to the right as the cœcum to the left. Like the latter, the *sigmoid flexure* of the colon is filled with feculant matter, in cases of constipation, especially during pregnancy. The descending colon reposes, superiorly, on the spleen, subsequently on the kidney and spermatic veins, explaining the production of varicocele, on the left side, by habitual consti-

pation. In front it merely offers a small number of fatty appendices. Its external surface is more regular and less sacculated towards its inferior portion, the three longitudinal bands disappearing. This arrangement would necessarily cause a difference in the appearance of its wounds. Where the unevenness exists, a transverse wound between two bands would but slightly separate; the contrary occurs in a longitudinal wound. Approaching the rectum, we remark inverse phenomena.

Being very near the anus, the sigmoid flexure of the colon, enclosed in hernia, would at once point out the nature of the mischief, by preventing injections from entering the gut. Its mobility, size, proximity to Poupart's ligament, and distance from the stomach explain why it has been chosen for artificial anus. In incising above the groin, we certainly have difficulty in reaching this intestine without injuring the peritoneum; but its serous membrane, retained for some days in the wound, unites so easily to it as to remove all inconvenience on that head.

We rarely meet with variations in the large intestine; F. Meckel considers that they never occur. However, in 1824, in a man who died of apoplexy, the cœcum and three portions of the colon were covered by small prolongations, in the form of a cul-de-sac, from two to six lines in length. Their openings into the intestines were narrower than their bases. Filled with very hard feculent matter, they were formed by thickened peritoneum and mucous membrane, which appeared to have escaped between the muscular fibres. Such a disposition would favour the production of ulcers, partial inflammations, and perforations.

Thus, from the cœcum to the commencement of the rectum, the large intestine forms a curve, the two extremities of which are external to the sacro-vertebral angle on the sacro-iliac symphysis, whilst its enlarged portion, or the arch, corresponds to the superior limits of the umbilical region. The convolutions of the small intestines, with their principal vessels, are enclosed in this large circle.

Mesentery.—This fold, extending like the intestine, which it fixes in front of the spine, from the second lumbar vertebra to the right iliac fossa, thick at first, encloses the aorta and vena cava, numerous glands, and all the arteries derived from the superior mesenteric, by its concavity, to form the very rich plexus, running to the concave border of the small intestines. All the trunks of the mesenteric veins are equally enclosed, and its wounds are particularly dangerous, from the consequent hemorrhage. Besides the glands, it contains numerous lymphatics, and the greater portion of the lacteals. As almost the whole of the inferior half of the absorbent system must traverse its posterior portion to arrive at the thoracic duct, its glands

frequently swell, sometimes forming a considerable mass. The digestive canal being always pushed forwards, or to the sides, tumours may easily be felt through the walls of the abdomen.

The mesentery allows the intestines to move from one point of the abdominal cavity to another, and in this way they may be injured, in performing paracentesis in dropsy; whence the recommendation not to introduce the trochar too deeply. But these fears have little foundation, as the instrument may always penetrate some inches without injuring the intestinal canal, and still less the arteries of the mesentery, which some persons maintain. The puncture being made at a time when the abdomen is much distended by fluid, the intestines, forced back into the loins, are far from floating; and if they even separated from the vertebral column, the walls of the abdomen, being often more than a foot distant, and the mesentery only five or six inches, there would always be a considerable distance between the alimentary canal and the point of the abdomen traversed by the instrument.

The disposition of the mesentery undergoes many varieties; the most singular being that cited by M. Cruvelhier. The fold extended from the concave surface of the liver to the pelvis. The large intestine, being extremely mobile, could have entered into any species of hernia as easily as the small.

The transverse *mesocolon* divides the interior of the abdomen into two cavities, the inferior filled by the small intestines, the superior enclosing the stomach, spleen, and liver. Its elongation, where the abdomen has often been distended, allows it sometimes to descend to the pubes, losing all its habitual relations. The inferior portion of the duodenum, the superior mesenteric artery, and colic branches are on its posterior margin. It is important to remember that its convex border, or rather the whole concavity of the large intestine, is accompanied by arteries of considerable calibre; as, in hernia, we might be obliged to remove a portion, in order to attempt invagination.

Omenta.—The *gastro-hepatic omentum*, extending from the concave surface of the liver, principally from its horizontal fissure, to the lesser curvature of the stomach, contains the hepatic artery, vena porta, lymphatic glands, and, on its right border, the excretory ducts of the bile; below, and to the right of which, we find the *foramen of Winslow*, or the orifice of the *posterior cavity* of the omentum.

The anterior wall of this cavity is formed, partly, by the gastro-hepatic omentum, subsequently by the posterior surface of the stomach, and, finally, by the omentum, reaching from the greater curvature of the latter region to the convex border of the arch of the colon; behind are the left lobe of the liver, the vena cava, aorta, cœliac axis, and pancreas.

As the posterior cavity of the omenta is limited, inferiorly, by

the transverse mesocolon, and its opening to the right, between the biliary ducts, vena cava, the right colon, and liver, may be obliterated after disease of the peritoneum, it is occasionally the seat of encysted dropsy, of collections of pus or blood, of which there are many examples. We may imagine that a portion of the intestine might enter and be constricted.

The *great* or *gastro-colic omentum*, attached by one of its double folds on the great curvature of the stomach, and by the other on the arch of the colon, spreads over the whole anterior portion of the small intestines, which can hardly be implicated in the umbilicus or other openings of the linea alba without pushing it before them. These kinds of herniæ are, therefore, almost always omental, as well as intestinal. In consequence of its superior attachments, patients, suffering from epiplocele, more particularly of the groin or perinæum, are almost always tormented with colic, and occasionally nausea. This covering, though fine, encloses arteries of sufficient size to render its wounds dangerous. In peritonitis it may contract adhesions, forming various bands, capable of producing symptoms of constrictions, if the intestines become implicated between them. A cavity may also thus be formed between it and the anterior wall of the abdomen, which, becoming filled with pus, is easily transformed into abscess capable of cure, if it terminates by opening externally. If, on the contrary, it were merely filled with serum, the result would be a species of encysted dropsy. In partially uniting to the surface of the intestines, the omentum interrupts their peristaltic motion, causing more or less pain. Several little sacs may result, and produce abscess or cyst. We must remark that the omentum extending more to the left, paricentesis is, in preference, practised on the right, although the liver generally descends lower than the spleen.

General remarks.—The disposition of the abdominal viscera, at birth, differs sufficiently from that of the adult to allow of some particular deductions. The cœcum, and its appendix, nearer the umbilicus, as completely enveloped in the peritoneum as the small intestines, are far from being so firmly fixed in the iliac fossa, and may be displaced, and form herniæ, more easily than in the adult. The small intestines are naturally pushed to the right by the transverse and descending colon, which are slightly inclined to the left. Does not this peculiarity concur in rendering inguinal and crural herniæ, more frequent on the right than on the left? and is not this frequency favoured in the infant, as in the adult, by the obliquity of the mesentery? The stomach, less curved, and the pylorus, nearer the umbilicus, cause the great omentum, but little developed at that age, to extend more to the left, and epiplocele to be more frequent on that side. The spleen descends below the false ribs. The liver, filling the whole of the right hypo-

chondrium, a large portion of the epigastrium, and the superior right portion of the umbilical region, gives the abdomen the disproportionate size which it then presents. The prominence of the abdomen in front also arises from the lumbar fossæ being but slightly developed, and forcing the organs filling them in front of the spine. The pelvis of the fœtus is so little developed, that all the viscera are retained within the proper abdominal cavity. The uterus, with its appendages, during pregnancy, and the bladder, when distended with urine, forced out of the pelvis, as in the fœtus, may, from that circumstance, be injured, in penetrating wounds of the abdomen.

The situation of the organs within the abdomen changes with varying attitudes. In the upright position, for example, the diaphragm and the vertebral projection increases, forcing the viscera forwards and downwards. In the horizontal position, on the contrary, the intestines roll up against the diaphragm, or, applying themselves on the sides of the spine, leave the iliac regions, when the pelvis is more raised than the thorax. The soft parts, enclosed within the abdominal cavity, obeying in general the laws of gravity, it is in this latter position, or on the back, that patients should be placed, when we would examine the condition of parts through the abdominal parietes, or perform any operation upon the walls themselves.

The abdominal parietes are elastic, and easily depressed. Instead of projecting forwards, they present more or less of an excavation in thin persons. The iliac region, especially, becomes sometimes so concave that, if we examine attentively, we may easily recognise the sacculi of the cœcum on the right, the sigmoid flexure of the colon on the left, and, internal to each iliac fossa, the prominence formed by the psoæ muscles, and the sacro-vertebral angle a little higher up. Thus, the thumb, passed obliquely from above downwards, and within outwards, on a line drawn from the sides of the sacro-vertebral angle to the centre of the crural arch, may suspend the circulation in the corresponding limb. This compression in the course of the iliac arteries is exceedingly useful in surgery; on the one hand, because patients bear it better here than on the body of the pubes, or on the aorta; on the other, because there are sufficiently numerous instances in which it is very difficult to apply it on these latter situations. In removal of the thigh at the hip joint, for instance, the ligature of the femoral above the profunda, or of the external iliac; finally, in wounds of the artery itself, this would be a resource not to be neglected.

We must not conclude, from what has been said, that there really exists a cavity behind the abdominal parietes; they are, on the contrary, constantly moulded on the viscera. By this remark, already frequently made, we comprehend how fluids, thrown out into the cavity of the peritoneum, after wounds or

inflammation, do not always descend towards the most dependent point during life, and why we find them accumulating sometimes in one, sometimes in another spot, according to the situation of the disease or injury. Thus, in penetrating wounds, when vessels of any size are divided, the blood, instead of running, as we should expect, into the lumbar fossæ, or true pelvis, is generally diffused, or forms a cavity for itself, near the wounded organ. It is thus that circumscribed abscesses are produced, as was, in the first instance, pointed out by Petit, junior.

The reason why there is no cavity in the abdomen is easily explained. As the walls of this region are composed of soft parts, the pressure of the atmosphere necessarily keeps them applied on the organs placed behind them, whose motions they follow. Being muscular, we may say, that they press the viscera so actively, that, from being curved and convex, anteriorly, they may become straight, from the sternum to the pubes. Their depression, on the contrary, is altogether passive. If this point were admitted, it would be one more argument in favour of those physiologists who maintain, that the stomach is not inert during vomiting. In fact, during that effort the epigastrium becomes deeply excavated, the chest approaches the pelvis, and the stomach seems to borrow the assistance of the abdominal parietes, to sustain it during its contractions. In this condition the recti muscles incline towards the diaphragm, and curve strongly backwards. As contraction would tend to restore them, we should naturally conclude that they are here in a state of relaxation; that, so far from compressing the stomach, they uniformly follow its contraction, and are, as it were, drawn in by it.

Solid, and at the same time elastic, the walls of the abdomen resist, and sufficiently yield to external violence, for blows, falls, or any sudden pressure to rupture the liver or the gall bladder, the spleen, kidney, stomach, duodenum, jejunum, ilium, cœcum, colon, bladder, the aorta, whether aneurismal or not, the vena cava, without leaving any external traces. Their reaction is so violent upon the viscera, that, in powerful exertion, they may produce the same mischief. When they relax, the digestive organs, habitually distended by gas, dilate and follow them; hence one of the causes of congestion, hemorrhage, of eccentric rupture, and the necessity of bandages, or belts, in individuals so predisposed. If the greater contractility be in the walls, the viscera are much compressed, and exposed to concentric rupture; but under no circumstance is there any space in the abdomen. Hence we may understand that the blood effused would proceed nearly as in the substance of a limb; that it would form collections between the convolutions of the intestines, the liver, and stomach, between the diaphragm and

spleen, in the loins, the iliac fossa, and the pelvis, more because the resistance here is less, than on account of its own weight; that it would form large collections between the omenta, or between the surface of the intestines, and abdominal parietes, instead of entering the more dependent parts; that these collections might burst into the stomach, the large intestines, or any other part of the alimentary canal, as well as into the bladder, across the diaphragm, and externally; that we must, moreover, treat these collections as abscesses, when we can no longer hope for resolution; that the clots remaining may alter in structure, and appear long afterwards as free concretions, or as more or less adhesive patches, capable of remaining months, and even years, as Pelétin has observed, on many occasions. In a word, it was upon this that the younger Petit, J. Bell, Fourcade, &c. founded their argument, that, instead of being carried by its own weight, the blood then merely circulated from the influence of a *vis à tergo*: an almost incontestable fact, when the fluid concretes rapidly, but not so in a contrary case.

What I have said of blood, extends also to bile, water, digestive matter, pus, foreign bodies; in short, any thing that may arise, either from within or without, remaining free in the peritoneal cavity.

It is, besides, quite sufficient to decide, that perforating wounds of the different canals, or sacs of the abdomen, are not always fatal.

The perpetual contact of these organs with each other renders their morbid agglutination very common, on the one hand, and the frequent transmission of their pathological collections by means of accidental openings. Equally in contact with the parietes of the abdomen, the intestines account for the character peculiar to certain abscesses, which have long engaged my attention. I speak of the deposits occurring in the substance of the abdominal walls, and from which the pus throws off a decided odour of stercoraceous matter, although it does not at all communicate with the intestine.

CHAPTER NINTH.

OF THE PELVIS.

Terminating the trunk, inferiorly, the pelvis, as it were, completes the abdomen. Replaced, anteriorly, by the hypogastrium and iliac fossa, it supports the haunches, externally, and is continuous with the loins, posteriorly. By uniting to the inferior extremities, it produces the inguinal fissure in front, and the subischiatic depression posteriorly. The kind of wing which it presents, superiorly and laterally, forms the lower limits of the flank. Its irregularity scarcely allows of any general examination, and we are, therefore, obliged to commence our study of the several regions with the proper pelvis. Its varieties, in the two sexes, will, however, lead us to regard it successively in the male and female.

SECTION FIRST.

EXTERIOR OF THE PELVIS.

Constituted by the haunches, pubes, and sacrum, the pelvis, closed below by the perinæum, supports the external genital organs in front.

Anterior region.—This region, formed by the symphysis pubis, and the collections of soft parts, which it supports, or by which it is covered, encloses, in man, all the external sexual organs. Continuous with the hypogastrium, superiorly, it is limited, inferiorly, by the perinæum, and, on each side, by the groin. It, consequently, comprehends three distinct portions, the pecten, scrotum, and penis.

Pecten.—Forming, of itself, the pubic region, by uniting with the clitoris, in the female, where it is known as the *mons veneris*, the pecten, more prominent in the fœtus and infancy, is, also, a little more so in the male than in the other sex.

The *skin*, remarkable for its thickness, the numerous follicles it contains, and the quantity of hair covering it, of a reddish or brownish colour, and unctuous, is generally moistened by sebaceous secretion. Of a dense texture, it is, nevertheless, susceptible of distension, by the gradual developement of tumours between it and the bone, or, rather, in the substance of its follicles. M. Faneau de la Cour removed a tumour of this description, of the size of an adult head. Descending on the penis, or spermatic cord, it rapidly becomes thin.

The *subcutaneous layer*, a melange of interlaced filaments and membranes, a species of elastic cushion, analogous to the subcu-

taneous layer of the hand and fingers, is continuous, at all points, with the *fascia superficialis.* Sometimes an inch thick, and even more, this appears destined to diminish the violence of shocks, to which the pubic eminence is liable. Its inflammations are generally very painful. Its filamentous tissue, its union with the skin and periosteum, allow pus, formed here, easily to reach the scrotum, or labia majora. Supported by a solid articulation, enclosing very large veins, exposed, by its projection, to external violence, it is sometimes the seat of sanguineous effusion, easily converted into abscess, principally among females. Should there be any doubt of resolution succeeding, these collections must be opened at once and largely, as the thickness of the skin would delay their bursting almost ad infinitum. The same may be said of any other abscess or collection at the part.

The *fibrous layer* is not a proper aponeurosis here, neither is it simply the periosteum. It is a membrane resulting from the interlacement of the internal pillars of the inguinal ring, of the fibres from the origin of the recti muscles of the abdomen, and of the gracilis. Uniting, in a direct manner, to the femoral aponeurosis, and by its anterior surface with the preceding layer, it gives origin to the suspensory ligament of the penis, and is thus blended with the fibrous covering of that organ.

The *vessels* of this region cannot, under any circumstance, cause fear of hemorrhage. The small *arteries* are furnished by the external pudic. The *veins* empty themselves either into the internal saphena or vesical veins, by passing beneath the arch of the pubes. The *lymphatics* follow the same course, and terminate, principally, in the superficial glands of the groin. Finally, the *nerves* are derived from the internal pudic.

The *skeleton*, the only really important part of this region, comprehends the articulation of all that portion of the pubes extending to their spine. This symphysis, remarkable in manhood for its solidity, renders luxation of the pelvis, in front, more difficult than fracture. In some women, the intervening fibrocartilage, occasionally, during pregnancy, swells to so great an extent, that its mobility becomes sufficiently extensive to produce lameness, or to require several weeks repose before the accouchement. The large serous surface, in the centre, explains the frequent presence of pus, &c.

The natural thickness of the inter-pubic cartilage, and the contact of its posterior margin with the bladder, led M. Bruner to introduce a trochar through it into the bladder, during retention of urine; but it is sufficient to remark, that, in a great number of subjects, the point of a scalpel will scarcely thus reach the bladder, to show the value of such a suggestion.

The fibrous elements of this symphysis are so susceptible of imbibing fluids, in some females, that we should always bear them in mind during difficult accouchements, before having recourse to any serious operation. Such a disposition would render the

operation for separation of the bones of the pubes (*symphyseotomei*) more easy.

As the separation of the pubes, almost inevitably, produces considerable mischief in the posterior symphyses, this should be performed with the greatest gentleness, and, as the pubic articulation occasionally becomes ossified, it has been recommended to replace this operation by the section of the bodies of the pubes themselves, and their ramus, through the obturator foramina. There, in fact, the bladder would run no risk, and we should then obtain a considerable increase in the antero-posterior diameter, without re-acting upon the articulations. The operations would be still more easy, if we performed a simple section of the carious or necrosed articulating surfaces.

The epiphysary prolongations, described by some authors as rudiments of the marsupial bones, and which mount from the superior border of the pubes into the substance of the abdominal parietes, would interfere in puncturing the bladder, above the pubes, or in the high operation for lithotomy, should they acquire any degree of magnitude. Considerable inconvenience must occur where the ossification extends from the symphysis itself, occupying the linea alba, as related by Roberts.

Penis.—Attached to the pubes, from which it appears to arise, superiorly, the penis is prolonged by the urethra to the perinæum. Extremely variable as to size and length, according to the age, individuals, the state of erection, &c. it is cylindrical, hanging in front of the scrotum. During erection, it presents a superior surface, grooved by a fissure, enclosing the principal vessels, and dividing two rounded eminences, separated from the urethra by two fissures, sometimes as deep as the superior. Its root is generally a little smaller than the middle portion of its body, and its anterior extremity commonly swells out in a marked manner to form the glans.

Remarkable for its fineness, thinness, and elasticity, the *skin* of the penis merits particular attention. Thick, covered with hair, and enclosing numerous sebaceous follicles towards the root, and, on the superior surface of the organ, it becomes thin and smooth in front. On the inferior surface, where the hair is in less quantity, the follicles are very large. The matter secreted by them rapidly dries and hardens. It, also, frequently accumulates in their interior, forming granulations, occasionally acquiring considerable size.

The integuments of the penis, deeper coloured on the scrotal than abdominal surface, slide so freely upon the subjacent layers, that they may be drawn from the root towards the glans, and reciprocally. There are, consequently, two things to be dreaded in amputation of the penis; firstly, leaving more skin than is necessary for the parts to cicatrise, and, secondly, removing too much, and thus preventing union. In the former case, it folds upon itself, the edges of the wound become rounded, and cicatri-

sation proceeds with difficulty. In the latter, it retracts, more or less, towards the pubes, leaving the stump uncovered. This last accident is especially to be feared, where the disease, requiring amputation, is a tumour of any magnitude. Then the pathological production, having pushed the penis backwards, and drawn the integuments forwards, leads this membrane to retract considerably after the operation.

In folding upon itself to form the prepuce, the skin insensibly assumes the character of mucous membrane. Slightly rose-coloured, it becomes the seat of abundant secretion in the circular groove, separating the corona glandis from the body of the penis.

This secretion, in careless, dirty individuals, becomes so acrid as to give rise to inflammation and excoriation of the parts, producing what is termed *spurious gonorrhea*, which has more than once been treated for months as syphilis, when it would commonly disappear in a few days, by the application of simple lotions.

Terminating beneath the glans, this groove is interrupted by a fold, termed *frenum*, which, varying in length, may approach, more or less, to the meatus urinarius. When too short, or prolonged too much forwards, it tends to draw the gland on the inferior surface of the penis, preventing copulation, or, at least, rendering it very painful; when too long, the extremity of the penis is too much elevated, and the emission is not directed towards the neck of the uterus. The small cul-de-sac, existing on either side, being cleansed with more difficulty than the rest of the organ, is frequently the seat of chancres, and the cause of the destruction of the frenum.

The prepuce, taken as a whole, is a portion of a canal open anteriorly, and terminating, posteriorly, by a circular cul-de-sac. Its orifice, before puberty, is sometimes so small as scarcely to allow the passage of urine. Thus, it terminates, among some children, by forming a small pouch, where the fluid accumulates before it escapes; hence the calculi, frequently met with. Occasionally, in manhood, preserving the narrowness of infancy, the orifice of the prepuce may not only thus interrupt the passage of the urine, but, also, render copulation extremely difficult, from the impossibility of uncovering the glans. Opposing, also, the cleansing of the interior of the sac, the sebaceous matter, becoming more acrid, and secreted in larger quantity, produces considerable inconvenience. It may also occur, that, although allowing the relaxed glans to traverse it with difficulty, it may completely prevent it during erection, rendering it equally difficult to treat chancres, or inflammation of its internal surface. This latter is *accidental phimosis*, the former *congenital*.

The narrowness of the opening of the prepuce, in some cases, determines that, after having, with some difficulty, uncovered the glans, by drawing the prepuce behind the corona, where the penis

is less in volume, it is impossible to restore it, and that the subsequent constriction may give rise to gangrene, or inflammation of variable intensity. This accident, termed *paraphimosis*, depending upon the manifest swelling of the penis during erection, is rare among children; where, however, we occasionally meet with it. Finally, the skin of the penis, and principally of the prepuce, is so thin that in infiltrations it becomes quite transparent.

The *subcutaneous layer*, a prolongation of the *fascia superficialis*, elastic, soft, extremely extensible, and divisible into several laminæ, never encloses fat, unless it be near the pubes, and adheres but loosely to the subjacent parts. Being blended with the other tissues in the tegumentary fold forming the prepuce, inflammation may there produce circumscribed abscess, whilst, at other points, the morbid fluid spreads with the greatest facility from one point to another; therefore, in order to prevent the destruction of the skin, we must make *early* and *large* incisions. Being enclosed, in front, between two cutaneous layers, unsustained by any solid body, it receives fluids more easily, considerably elongating the prepuce, at the same time contracting its orifice. *Inflammatory phimosis* is frequently produced by this accident.

The *fibrous membrane*, constituting, as it were, the skeleton of the penis, determines its form, size, and solidity. A cylindrical canal, it is divided into two, at the posterior three fourths, by a vertical septum, which insensibly disappears in its anterior fourth. Composed of strong and very dense fibres, variously interlaced near the pubes, it is, at first, about a line in thickness, and gradually becomes thinner towards the glans, where it is no more than a mere fibro-cellular membrane, sufficiently dense, however, to prevent all direct communication between that organ and the cavernous bodies. Its inferior surface is grooved for the reception of the urethra, which is united to the body of the penis by cellulo-filamentous tissue, allowing of its being completely isolated. Numerous filamentous bands interlace in its interior, forming a network similar to the cancelli of long bones, serving to support the expansion of the vessels, and producing with them the spongy, erectile tissue, known by the name of *cavernous* tissue. It results from these peculiarities of structure that swelling of the penis is insurmountably limited by the resistance of its fibrous sheath; that cicatrices, occurring from wounds implicating that canal, generally change the direction of the organ; that, during violent erection, or in intense gonorrhea, if we endeavour forcibly to bend the penis, it would break rather than bend, and that these lacerations might be succeeded by hemorrhage from the urethra. It is thus that we may explain the relief succeeding the accident; but, on the other hand, an incurable fungoid, aneurismal, or varicose tumour may result. The septum of the cavernous bodies becoming ossified, as M'Clellan has related, would, we may imagine, render am-

putation of the penis very difficult, and keep it in a continual state of forced painful erection.

Arteries.—The two *dorsal arteries* of the penis, enclosed in the subcutaneous layer, running from behind forwards, in the median fissure, anastomose so frequently with each other as scarcely to form more than one anteriorly. M. Blandin has seen the two pudic arteries anastomose beneath the symphysis, and give off only one dorsal artery. Diemerbroeck considers that they frequently arise from the external pudic. When furnished by the vesicular, the obturator, or any other branch of the hypogastric, they commonly coincide with diminished volume of the internal pudic. We will, therefore, recur to this in treating of the perinæum. As far as the prepuce, they are sufficiently large for some surgeons to have recommended cutting beneath, or on the side of the organ, in phimosis, in order to prevent hemorrhage. These fears being unfounded, we have continued the incision superiorly, and on the median line, although Celsus has recommended the inferior surface for other reasons; M. J. Cloquet, however, has in our days drawn the attention of surgeons to this operation. Lodged in an elastic and very moveable layer, these arteries retract considerably after amputation; and the albugineous sheath of the cavernous bodies preventing the stump from shortening, to follow the cutaneous and cellular investments, they appear to retract more than they in reality do.

The two *cavernous arteries*, situated in the spongy tissue externally, and slightly inferiorly near the fibrous membrane, do not, on the contrary, retract at all, being prevented by the erectile tissue. We have, consequently, four arteries to tie after amputation of the penis, two superficial and two deep, besides secondary branches. All these are derived from the internal pudic. We may also add those which come from the artery of the septum and external pudic. The dorsal artery, instead of being furnished by the perinæal, sometimes arises directly from the internal iliac, as I have seen upon two occasions.

Veins.—The venous system, nearly of itself, forms the cavernous tissue, and gives very large veins to beneath the skin. The latter interposed in the lamellæ of the subcutaneous tissue, very frequently swell to such a degree as to cause pain, or even excoriation, during connexion. We, therefore, not unrarely find hemorrhage resulting. As the largest empty themselves into the vesical veins beneath the arch of the pubes, phlebotomy may advantageously be practised upon them, during acute diseases of the bladder, and in inflammatory affections of the penis. To succeed, we should press upon the vessel, which is commonly unique, with the thumb, near the pubes, whilst we open it with a lancet. But as the corresponding artery may at the same time be wounded, this method is almost abolished, and probably wrongly so. Some small veins, in the lateral and inferior por-

tions, running by the external pudic into the saphena magna, present no peculiarity. Can the erection, of which so much has been written, and which is not the less inexplicable, be accounted for, by the relation of the veins with the small muscle, discovered by Houston? Arising from the ramus of the pubes, to run transversely over the dorsum of the penis, at the union of the two crura, where it becomes tendinous, this small fasciculus, the existence of which I have proved in several dogs, embraces the dorsal vein or veins in its middle portion, so as to compress and close them when it contracts. Thus, preventing the return of the blood, without interrupting the afflux, we perceive the phenomenon produced by its action, and how necessary it is to preserve it in operations, if it were well demonstrated, that such, in fact, were its functions in man, and that numerous other veins did not escape from the cavernous bodies.

Lymphatics.—Some accompany the cavernous vessels, and pass to the pelvic glands; others ramify in the superficial layer. Larger on the dorsum and sides of the organ, they, with those from the glans and most from the urethra, run into the glands of the groin. This arrangement explains why chancres or other diseases of the glans and prepuce so frequently produce bubos in the inguinal region, and how these bubos may be efficaciously treated by mercurial friction on the penis; whilst deep-seated mischief, without lesion of the external layers, implicates more particularly those in the pelvis.

The *nerves*, being furnished by the internal pudic, are similar to the arteries external to which they run. They may easily be wounded in phlebotomy of the penis. Nevertheless, they would be avoided by puncturing the vein lengthways, and by keeping it near the median line. In wounds and amputations, we should avoid implicating them in the ligature with the vessels.

Glans and urethra.—The urethra can be studied with most advantage in the perinæum. We will only, therefore, remark, that by spreading out anteriorly, it forms the glans applied on the free extremity of the cavernous body, and that after amputation of the penis, it is the rule to introduce a catheter, keeping the urine from inundating the wound, as much as to prevent the orifice being contracted or closed by the cicatrix. This advice is, doubtless, useful and prudent; nevertheless, some individuals have got well equally soon, in whom it was quite neglected. An old man came to the Hôpital de la Faculté, in the summer of 1824, having cancer of the penis. After amputation, he was obstinate, and would neither allow the wound to be dressed, nor a catheter to be introduced. Notwithstanding, the cicatrisation, which proceeded regularly, was completed in about five weeks. We must also remark, that wounds are more dangerous on its inferior than on its dorsal surface. The former are disposed to become urinary fistulæ, whilst the latter can only become serious from hemorrhage, or some nervous affection.

Scrotum.—A species of sac, containing the testicles and their cords, firm, larger, wider at its base than at its summit in infants, children, and when suddenly exposed to cold, the *scrotum* is elongated, soft, and pendulous, and, as it were, fixed by a simple pedicle to the pubes in manhood and old age. Bifurcating, superiorly, to embrace the root of the penis, and to become continuous with the supra-pubic rings, it is prolonged, inferiorly, on the median line of the perinæum, by a soft projection, and is separated laterally from the thighs by two generally very deep fossæ, at the bottom of which we frequently remark excoriations, especially in very young children. Finally, we occasionally meet with instances where its two portions remain isolated, resembling, to a certain extent, the labia majora of the female. Hence, most of the histories of hermaphrodism, so common in ancient books. The skin of the scrotum, like that of the penis, is very thin, soft, elastic, and mobile. It is, moreover, covered with hair and follicles, forming so many granulations on its surface. Its colour is always deeper than that of the parts surrounding, and its surface is corrugated. It is relaxed and elongated when the body is heated by labour, and, on the contrary, contracts and folds from cold, and numerous other causes. Secreting very actively, it readily becomes covered with a thick humour, more or less irritating, which is the principal agent in the production of most of the affections to which it is liable; such as cutaneous eruptions, &c. Several reasons lead me to consider that the disease described by Pott, under the term of chimney-sweeper's cancer, equally depends upon this peculiarity. On the median line, we remark a kind of seam, which, continuous, on the one hand, with the root of the penis, and prolonged, on the other, backwards, towards the anus, is a guide in the incisions practised on the scrotum.

In the removal of tumours, developed beneath the skin, we may, from its great elasticity, cut away a larger portion than in any other region of the body.

We can, if necessary, divide the *subcutaneous tissue* into several lamellæ, which are, in reality, merely layers of the fascia superficialis; under the name of *dartos* it envelopes each of the testicles. To form a correct idea of it, it should be examined in the fœtus, before the formation of the scrotum, and as a portion of the general subcutaneous fascia. Then we see that it passes over the ring, and is continuous with the fascia propria, without any alteration. The funnel-like prolongation, considered as carried forward by the testicle to the scrotum, has no real existence. The *gubernaculum testis*, admitted by almost all authors since Hunter, is a simple process of the fascia propria, rendered continuous with the subcutaneous layer by means of the inguinal canal. What I here describe in infancy, has been observed by M. Manec in an adult, where the testicle never escaped through the ring. It is then as in the abdomen,

lamellous, nearly an aponeurotic layer, which draws upon the testicle as it passes outwards. When this is the case, the dartos constitute two independent pouches, approximating, by the internal portion of their external surface, to form the double septum, separating the testicles, beneath the urethra and penis.

It is continuous, in an evident manner, with the cellular tissue of the perinæum, inguinal region, abdomen, and penis. Its fibres are elastic, spongy, and reddish, in some individuals. Ancient anatomists, who explained the corrugations and retraction of the testicles by its contractions, endowed it with muscular texture.

Modern authors entirely reject this opinion; I think they are wrong. In many subjects, the parallel, undulating, villous, soft, and very elastic fibres, the red tissue,—all, in a word, assimilate the dartos to the muscular coat of the stomach. My opinion is, that the cellular element may be transformed into fleshy tissue, as I have before observed. The term *dartoide*, long employed, extremely well designates this union of tissue, wherever it be met with.

Situated in the subcutaneous tissue, *hydrocele by infiltration* may succeed a similar affection of the abdominal parietes, the perinæum, or inferior extremities. The same occurs in effusions of pus, succeeding every species of abscess of the surrounding regions; of urine, in rupture of the urethra, as well as the fluid which we endeavour to inject into the tunica vaginalis, when the canula is not properly maintained; and of blood, in wounds of the external pudic. The facility, with which these various effusions give rise to great mischief, furnishes, in all cases, a reason for *promptly* and *largely* incising the skin, under such circumstances.

The very few adipose cellules of the scrotum become more abundant higher up on the cord, or nearer the perinæum, causing the scrotum to appear much smaller in fat than thin men.

The *fibrous tunic* is the first which moulds over each testicle and its cord. We have seen, in the inguinal canal, that, arising from the circumference of the ring, it is, evidently, continuous with the cellulo-fibrous division of the aponeurosis. At first of a dense texture, it soon relaxes, assuming the softness and all the characters of simple cellular tissue. Quite inferiorly, it is so blended with the preceding, that it is almost impossible to separate them. In ancient herniæ, it sometimes acquires sufficient thickness to produce all the phenomena of strangulation, when the viscera escape through one of its slits. This accident, however, can scarcely occur, excepting in the antero-superior portion, from its greater elasticity in other parts.

The *muscular tunic*, or *cremaster*, represents a series of arches, derived by the traction of the testicle upon the inferior fibres

of the internal oblique. Hesselbach was one of the first to remark this disposition, but MM. J. Cloquet and Seiller demonstrated it. Like Scarpa, I have always met with it in the dead subject. To examine it accurately, the aponeurosis of the external oblique must be reflected from within outwards, the internal pillar of the ring having been previously divided. Then, drawing the cord slightly forwards, we perceive that the fleshy semicircles of its anterior surface are derived from the internal oblique, and attached, by their extremities, to the two sides of the ring. Some of them, however, appear to me to be attached to the body of the pubes, on each side of the cord. These fibres are, generally, so tense, and so little apparent near the rectus muscle, that several correct anatomists appear to doubt their existence internal to the cord. Following the method which I have recommended, it is always possible to observe, that, nearly straight at first, they gradually curve as they descend, forming loops of increasing length. In this examination, they must be traced from their external to their internal extremity, not forgetting that they are much more numerous in front than behind, where they are sometimes wanting.

At birth, the testicle, as yet behind the ring, meets the posterior surface of the internal oblique, and pushes its fibres across the external orifice of the inguinal canal into the scrotum, leaving their extremities at the points which they originally occupied.

Those individuals, who, for many years, have suffered from herniæ, are the best subjects for the study of the cremaster. Indistinct, and formed of delicate fibres, in many persons, it is very strong in others. We know, positively, that it is the principal agent in raising the scrotum towards the ring, occasionally acquiring so great thickness, that it has been supposed capable of producing herniæ, solely by its contractions. This thickening of the cremaster, joined to a similar affection of the other coverings, in ancient descents, or hydrocele, has, more than once, been attributed to the tunica vaginalis, or hernial sac. However this may be, we ought to be prepared for a considerable thickening of parts, in operations for strangulated hernia, where the tumour is large, and has existed for a long period; whilst, in recent cases, all the membranes would be thinner than in the natural condition. The muscular sheath, long distended by the neck of the sac, at length appears to arise from the circumference of the ring, and to be confounded with the fibrous tunic, these two layers forming one fleshy aponeurotic membrane.

Generally designated the proper tunic of the cord, the *cellular layer* is formed, essentially, of the fascia propria; but we may say that it is, in addition, enveloped in a tunic belonging to the fascia transversalis, as the testicle can only draw upon it in traversing the opening in this latter fascia, or, rather, pushing it forwards, to form a funnel. The sheath of the cord, not en-

veloping the tunica vaginalis, terminates at the point where the vas deferens emerges from the testicle. Hence, it results, that in inguinal herniæ, which are not congenital, the viscera and the sac remain above the gland, which always, pushed inwards and backwards, is slightly connected, by its external surface, to the fleshy membrane.

In fat subjects, we find the sheath of the cord covered by rather a thick layer of fat, or simply by adipose pellets of various sizes, which may be the cause of some herniæ, and which form, among themselves, when they acquire any size, true adipose herniæ. They are attached to the constituent parts of the cord by means of lamellæ, or cellular filaments, sufficiently dense to admit of fluids collecting in various spots, thus forming pouches, or isolated cysts, constituting that termed *encysted hydrocele of the cord.* In this case, these tumours are generally situated between the cord and the ring. Nevertheless, as the cellular tissue is prolonged backwards, along the epididymis, to become attached to the other tunics, we can conceive the possibility of encysted hydrocele in the latter situation. The cord is almost always thrown inwards and backwards, because its cellular lamellæ are least adherent in front, which must be remembered in operations, that the trochar may be introduced in the anterior and external portion of the tumour, although the contrary is, occasionally, indispensable. These accidental cavities do not communicate with the interior of the peritoneum, and encysted hydrocele is, in cases of necessity, capable of being treated in the various manners recommended for hydroceles of the tunica vaginalis. In the adult, the *tunica vaginalis* represents a small bag, having no opening, which may be considered as formed of two portions, one adhering, by its external surface, to the cul-de-sac of the fibro-muscular membrane, the other intimately united to the surface of the testicle, but not entirely covering this organ, leaving its root, in some degree, enveloped by cellular tissue, attached to the internal surface of the other sheaths. This peculiarity explains what occurs when the vaginal cavity is filled with fluid, and that the testicle is, ordinarily, towards the internal and postero-superior region of the tumour. We should, therefore, as in encysted hydrocele, introduce the instrument at the anterior external and inferior point, when there is no anomaly.

Superiorly, the tunica vaginalis is not continuous, unless accidentally, beyond the inguinal canal, whilst, before birth, it communicates directly with the peritoneum, of which it is merely a prolongation. The viscera may enter here during intra-uterine life, and the infant be born with hernia, in which the testicle and displaced organs are in immediate contact. This hernia, termed *congenital,* leads to the same accident as any other; but the sac, being the tunica vaginalis itself, is not free

on its external surface, nor susceptible of being easily separated from the other envelopes. We have seen above, that in ordinary hernia, the cellular tunic keeps the organs above the testicle.

In that which we are now considering, on the contrary, the tunica vaginalis admits of their descending much lower. As in hydrocele, the testis and its cord are then pushed inwards and backwards. This canal, commonly obliterated, sometimes remains free in various points, although all communication with the abdomen has ceased. Should fluid collect in any of these cavities, there results a sort of encysted hydrocele, differing essentially, as to situation, from that already described, but requiring the same method of treatment. It also occurs, that, instead of completely disappearing, its abdominal opening is merely contracted, allowing of the viscera becoming implicated at an advanced period of life. I have seen two patients, in whom this was incontestably the case. In neither of these was there any thing to lead to the suspicion of hernia, before the operation was actually required, and the testes were free at the bottom of the scrotum.

In the natural condition, the tunica vaginalis is thin. Its interior is smooth and glossy, forming a very regular cavity; but when the fluid, which naturally lubricates it, accumulates in too large a quantity, or when hydrocele has existed for a long period, it may enlarge as far as the ring, in the inguinal canal itself, or become constricted by some bands, presenting the appearance of a double tumour. Sustained, externally, by the fascia propria, and even by the fascia transversalis, it may, by its distension, unravel and separate the fibres of these tunics, giving the hydrocele a sacculated form. It is at these fissures, that it becomes sufficiently thin for the fluid to exude into the surrounding tissues, when we inject carelessly, or when its own effusion overcomes the resistance. We thus explain the gangrenous inflammations of the scrotum, which occasionally occur after the operation for hydrocele, notwithstanding the wine has been properly injected into the tunica vaginalis; as also the cases of sudden resolution of the disease, mentioned by some authors. We may, for the cure of hydrocele, employ incision, excision, cautery, seton, a tent and injection, producing sufficient inflammation for the walls to become agglutinated.

When the peritoneal canal remains at birth, the tunica vaginalis may become filled with fluid, giving rise to *congenital hydrocele.* The treatment of this variety requires considerable attention. The inflammation produced by an operation would easily extend to the peritoneum. Injection appears especially dangerous, unless the inguinal ring be completely obliterated by pressure, properly applied during the introduction of the fluid, as I have once seen done with success. The tunica vaginalis, distended by the serum, whilst the testicle is retained in

the abdomen, or behind the ring, may receive a portion of intestine, producing *congenital hernia.*

In a word, the anatomical arrangement of the serous investment of the testes allows of *simple hydrocele*, without communication with the peritoneum; *congenital hydrocele;* or with communication, and which may co-exist with hernia of the same nature; *encysted hydrocele*, within the tunica vaginalis, produced by incomplete obliteration, at some point or points of the canal; finally, *encysted hydrocele*, without this membrane, or *in the cellular tissue of the cord.* These latter, existing sometimes in the form of hydatids in the inguinal canal, or very close to its external orifice, may resemble, and have been mistaken, more than once, for bubonocele.

The course which the *testicle* pursues during intra-uterine life, admits of its being arrested behind the ring, and sometimes, in manhood, even of its not having descended into the scrotum. Such is, doubtless, the origin of many of the histories of pretended absence of the testes; at least, we have scarcely any authentic accounts of subjects in whom they really did not exist. The case reported by Cabrole is not an exception, although the author says that he dissected the subject. However, M. Blandin relates the case of a man who had neither testicle, cord, nor vesicula seminalis of one side, and in whom the scrotum did not present the slightest trace of lesion. I have also met with a similar instance in 1827, in a subject between fifty and sixty years of age, in whom there were neither spermatic arteries, nor veins. M. Terreux, of Nevers, to whom I mentioned this case, informed me that he witnessed one resembling it about two years previously.

When the testicle remains in the canal, or when it tends to break through the ring, the pressure produced, and the swelling which it forms, have frequently led to the suspicion of incipient, and even of strangulated, hernia. We can readily understand the dangers of such a mistake, if we persist in returning the tumour, and especially in maintaining it by a bandage. It, however, may thus be pushed back without any very great inconvenience, in some infants, so as to remain behind Poupart's ligament, and escape at a later period by the crural arch, as in the case cited by Scarpa, to which I will return, in speaking of the inguinal region.

The retention of the testicle occasionally causes, at a later period, when it finally descends, a portion of intestine to follow, forming hernia, similar to congenital, although not occurring until twelve, fifteen, twenty, or even five-and-twenty years of age. This species of *vaginal hernia*, in adults, should not, however, be confounded with that already mentioned in describing the serous tunic of the scrotum.

The testis, retained in the canal, is subject to the same degeneracies which so frequently attack it in the scrotum, such

as scirrhus, cancer, &c. These may give rise to numerous errors in the diagnosis, and their extirpation would be very dangerous and difficult. Whether it be really wanting, or merely retained in the abdomen, it may be replaced by a bubonocele, as Fages, of Montpellier, appears to have observed, and cause considerable embarrassment to the surgeon. Lastly, it must be recollected, that varicocele, occasionally, produces atrophy of the testicle, that several individuals possess the power of drawing it up into the iliac region, between the aponeurosis and skin. A man, aged thirty-six, whom I saw in 1836, could raise it as high as the flank.

A kind of fibrous shell, the *tunica albuginea*, which immediately invests the proper substance of the testicle, is so intimately united to the external surface of the serous tunic, that it is almost impossible to separate them by dissection. However, hydatids, and other similar tumours, occasionally form between them, increasing in size towards the posterior border of the organ, where the lamellous cellular tissue is less dense. Filaments are given off from its internal surface, which, interlacing in the interior of its cavity, serve to sustain the seminiferous canals, causing them to escape with facility, in wounds of the testis. Petit relates an instance of a surgeon, who daily extracted a portion of the seminiferous canals, thinking that he was removing mortified cellular tissue, and thus completely emptied the testis.

Furnishing the *corpus Highmoreanum*, it thus appears to be prolonged upon the deferential canal, where it is much thinner. It, therefore, results, that in blennorrhagic or other enlargement, the tumefaction sometimes remains several days confined to the epididymis, before it extends to the testicle itself. If, notwithstanding the thickness, strength, and inelasticity of the tunica albuginea, swelling of the testis proceeds with so much rapidity, it depends upon the fine, elastic, and abundant cellular tissue, which is mingled with the glandular. However, this enlargement rarely exceeds certain limits in the acute stage.

As this tunic yields sooner in one point than another, in chronic enlargement, the tumour is ordinarily knobby and uneven. When once perforated or lacerated, the swollen tissue, enclosed in its cavity, escapes through the openings, quickly covering it with vegetations. Its anatomical arrangements cause it to be affected in two different manners: firstly, disease is transmitted to it by the tunica vaginalis; secondly, it is disorganised consecutively to the particular tissue filling it. The first occurrence, rarely serious, is remarked in hydroceles, and generally disappears with the disease which produced it. The second, comprehending various species of swelling of the testis, whether simple, venereal, or cancerous, is much more dangerous.

The *epididymis*, being the posterior superior portion of the

testis, and very firmly attached to the membranes forming the scrotum, prevents the gland from being quite free within its serous membrane, and places the various effusions of the tunica vaginalis, commonly, in front and externally. It is in some individuals of sufficient size to resemble pathological enlargement, when none in fact exists. I may add, that, instead of being behind, it is sometimes in front. I have seen numerous examples of this; four during the year 1836. In one patient, it occurred on both sides; in the others, it was confined to the left. Do not those cases in which hernia and hydrocele have been said to exist, behind the testis and cord, depend upon a similar predisposition?

The structure of the testicle explains how hydrocele may last for so many years, even for life, without its functions being interrupted. Its fibrous tunic forms a barrier, rarely broken down by the disease. It also explains the danger of not immediately uniting wounds penetrating as far as the seminiferous tubes, and, also, the difficulty of curing the fistulous ulcers resulting, when not properly treated. Finally, it accounts for the pain experienced when the organ is struck or compressed.

The almost complete isolation of the epididymis, in some individuals, the presence of insensible, rather flattened, but very distinct masses on the natural organs, may lead to the belief of supernumerary testes, when none exist. In consequence of the continuity of the epididymis with the seminal canal, it is always the first part implicated in congestions commencing in the urethra, so that its tumefaction is an almost certain indication, that the disease does not proceed from without. Its dense texture, and the reflexion of its canal, prevent the mischief from extending rapidly. We observe the reverse in the body of the testis, from the softness and delicacy of the seminal tissue. When hydrocele, produced by venereal enlargement, disappears without an operation, it is, that, the cause being removed, the effect is also dissipated.

When the effusion proceeds from without, the swelling of the testis, generally merely the result, disappears with its cure. Finally, the organ is so independent of the scrotal tunics, that it may remain healthy in the midst of various degeneracies. In one case, Delpech removed sixty pounds weight of diseased scrotum from around a testis.

The *spermatic cord* consists of the vas deferens, spermatic artery and veins, a branch of the epigastric, the genito-crural nerve, plexus of the great sympathetic, remains of the canal of communication between the peritoneum and tunica vaginalis, and cellular tissue, uniting these various parts among themselves, as in the inguinal canal.

The *vas deferens* is here a very important organ. Its flat-

tened form, grey colour, and position admit of its being isolated, and a portion removed without any difficulty, in order to produce atrophy of a scirrhous testicle, as proposed by Morgan, and performed by Lambert and Key; could such an operation be admitted by sound sense! Although it does not receive nerves from the cerebro-spinal system, it cannot be implicated in a ligature without causing peculiar and very intense pain, quickly producing syncope.

The *spermatic artery*, almost constantly external, and in front of the deferential canal, commonly remains single as far as the lower portion of the cord. It is sometimes sufficiently large to give rise to alarming hemorrhage, if wounded.

In ancient and large hydroceles, the cord being, as it were, decomposed, it may be found at some point of the tumour, differing from that which it ordinarily occupies. All authors have recommended its being cautiously avoided. Scarpa, in particular, has proved, that it may be wounded in the operation for hydrocele; and the more likely, as each of its branches is then larger than the original size of the trunk. Its natural volume and proximity to the deferential canal admit of its being exposed and tied without difficulty, as recommended by M. Mannoir and Sir C. Bell, to arrest the progress of sarcocele.

The *artery* derived from the *epigastric*, rarely of any magnitude, does not supply the testis. Distributing itself to the laminæ of the scrotum, it cannot produce effusion in puncture. After the operation for sarcocele, it habitually requires a ligature, as well as the preceding. Both are in front of the deferential canal, one external, the other internal. Small in comparison with their length, tortuous, soft, and enclosed in a layer of lamellous cellular tissue, they promptly retract when cut, and are sometimes secured with difficulty, where the ligature is not immediately applied.

The *spermatic veins*, tortuous, undulating, very large, two, sometimes three, four, and even more in number, are sufficiently evident as far as the epididymis, and generally situated in front and on the sides of the other canals. Long, soft, deprived of valves, continually drawn upon by the weight of the testicle, enveloped in loose cellular tissue, exposed to pressure in the inguinal canal, in consequence of the double curve which they are obliged to make, equally liable to compression in the iliac fossa, in front of the muscles, by the termination of the ilium or cœcum on the right, and the sigmoid flexure of the colon on the left, there is nothing surprising in their being frequently the seat of varicose dilatations, and that the varicocele should be very large. The species of knotty chain, which they form in this condition, gradually increases towards the testes, on account of their branches being more numerous near

the inferior extremity of the cord. Hence, if we would obliterate them by ligature or incision, so much extolled by Delpech, in these cases, we should expose them as high up as possible.

Nerves.—The fasciculus of the *great sympathetic* lies upon the spermatic artery. The *genito-crural* is situated behind. The *ilio-scrotal* runs between the fibres of the cremaster, consequently external to the cord. We easily explain, by these two last, the pains experienced by patients, towards the iliac crest and lumbar region, during the injection of any irritating fluid into the tunica vaginalis. The pain produced by the same operation, and by any compression of the testis,—a pain which the patient says *runs to his heart*, should be referred to the spermatic plexus. This plexus, and the accompanying vessels, having intimate relations with the kidney, we may thus comprehend the retraction of the testicle, observed in nephritic colic, and the formation of renal calculi. It has been supposed, that by tying the arteries separately after sarcocele, the nerves would more certainly be avoided; but they are most frequently too delicate and too close to the arteries to be preserved. In tying the whole of the cord, it is necessary to act promptly, and draw the ligature strongly and sharply, when we would immediately suspend its functions, and with them the pain.

The cellular tissue of the cord communicates directly with that investing the external surface of the peritoneum. We might suppose, from the precautions recommended by authors, to prevent the cord from running up into the abdomen, when separated from the testis, in castration, that it were endowed with great power of retraction. It is not so, however. Beyond the inguinal canal, the vessels and nerves which run towards the kidnies, the deferential canal which enters the pelvis, possess no such property, and the cremaster, which alone would be capable of it, has no action beyond the external ring. This inconvenience is, on the contrary, produced simply from the following reasons: that stretched and drawn down by the weight of the sarcocele, the cord is no sooner relieved from this mass, than it tends to resume its primitive position.*

Besides the proper *arteries* of the cord, the scrotum receives numerous others, which ramify between the various tunics, particularly in the subcutaneous layer. Hence they are frequently wounded by the first incision, in sarcocele, &c. When once divided, they retract so quickly beneath the skin, that they are better tied immediately than at the end of the operation. They come from the external pudic branches of the femoral, and from the superficial perinæal of the internal pudic;

* This reasoning does not at all appear to me to do away with the idea of the contractility of the cord; on the contrary, it rather tends to strengthen the opinion, for if it did not possess some power of the kind, the anormal distension would remain permanent, and it would not be able to resume its primitive position, as stated by M. Velpeau.—H. H.

more deeply we meet with another derived from the epigastric. It has long been considered that the hemorrhage occasionally succeeding puncture, in hydrocele, depends upon these. This is also my opinion, although it may, by chance, proceed from the spermatic. In a patient operated upon at the Hôpital de la Pitié, in October 1832, they equalled the dimensions of a crow's quill, and their principal ramifications could be distinctly observed through the skin.

Like the arteries, the *veins* run, principally, in the superficial layer, beneath the skin, where they frequently become large, tortuous, and varicose. Their accidental dilatation, determined especially by tumours of the groin, such as bubos, scrofulous glands, crural hernia, &c. constitutes *cirsocele*. Forming the external pudic, they empty themselves into the saphena; diseases of which would implicate them. When enormously developed, their size, and the disposition of the external cellular layer, mostly lead to considerable ecchymosis, after the application of leeches. Hence hematocele by infiltration, in contusions of the scrotum.

The *lymphatics* here form two layers, one for the envelopes running to the groin, and the other for the testicle and cord, which pass into the abdomen. Thus, diseases of the scrotum produce swelling of the glands of the inguinal region, whilst acute or chronic disorganisation of the testicle re-acts upon those in the lumbar region and behind the mesentery.

The *ilio-scrotal* nerve ramifies in the external membranes, as far as the subcutaneous tissue; but the scrotum receives its nerves, more especially, from the internal pudic. Thus, lesions of the scrotum excite more pain towards the perinæum than towards the inguinal canal.

Remarks.—The arrangement of the organs just described may, in the removal of scirrhous testicle, be studied under three principal heads; relative to the division of the investments, the dissection of the tumour, and the section and ligature of the cord.

In exposing a sarcocele, we are sometimes forced by the disease to comprehend a portion, of greater or less extent, of all the scrotal membranes in the form of an ellipse; otherwise, the integuments, weakened by prolonged extension, would allow the edges of the wound to roll in upon themselves, considerably retarding cicatrisation. As the integuments are thin, supple, and invested by several elastic membranes, one of which enjoys all the properties belonging to muscular tissue, the lips of the wound may be puckered, drawn, and rolled upon their internal surface, by the action of the muscular tunic.

The dissection of the testicle of necessity is more or less difficult, according to the extent of disease. Internally, it approaches so closely to the penis as to require great caution in regard to the urethra; but when there are no adhesions, the dartos

is sufficiently loose to admit of the parts being promptly isolated. In all cases, we find one or more branches of the internal pudic artery near this point, which should be tied immediately they are divided.

If we pass a ligature, formed of three or four threads, around the cord near to the external ring, so as completely to constrict it, we at the same time tie the arteries, veins, deferential canal, nerves, and cellular tunic; but to succeed, the part must be completely strangled. Without this precaution, the pain would be intense. Life would remain in the free extremity of the organ, which would speedily become covered with fungoid growths, capable of contracting adhesions with the circumference of the inguinal ring, as both J. L. Petit and I have seen.

Herniæ.—Whenever the viscera descend into the scrotum, the hernial sac, by degrees, separates the cellular tunic of the cord. When it is merely a bubonocele, the sac with its contents may easily enter without producing any alteration in the cord. When the disease is large, and of long standing, the deferential canal and spermatic vessels may have contracted very different relations. They appear to spread into a cellular membrane, and sometimes remain behind the tumour, prolonged to a considerable extent from each other. At other times the artery or the deferential canal is external, within or in front, as Ledian has observed, or even twisting in a spiral direction around the tumour, which M. Fardeau and I have met with. In this case, it would be dangerous to remove the sides of the hernial sac after the operation, as is still the practice of some of the older surgeons.

The cellular tunic also establishes a remarkable distinction between simple scrotal and congenital herniæ. In fact, as it terminates at the entrance of the vessels in the testicle, a tumour of the first species finishes there, by a kind of constriction; whilst, where the vaginal cavity forms the hernial sac, the displaced parts descend much lower. The relations of the peritoneal envelope with the surrounding tissues produce other important distinctions in operations.

Thus, even when the disease is of long standing, the accidental sac is capable of entering the abdomen, or at least approaching very close to the ring. In congenital hernia, on the contrary, the sac cannot rise, as it is solidly united to the constituent parts of the cord; reduction, therefore, must never be attempted. The cure of artificial anus would also be more difficult. This sac is generally thinner than the abdominal peritoneum; but in the other kind of herniæ it is thicker.

In young children, the very large and soft tunica vaginalis allows herniæ to slide behind, so that we are obliged to cross a serous cavity to arrive at the viscera. Hey gave the name of

infantile hernia to this tumour, of which he cites several examples. The same thing occurs in adults, but more rarely.

If all its layers were well separated, and their thickness did not vary so much, it would never be difficult to arrive at the displaced viscus; but they are often so confounded that they cannot be distinguished. If, even, we should be able to recognise the superficial from the muscular layer, which is generally possible from their anatomical characters, we should be embarrassed by the cellular fold surrounding the cord, the thickness of which varies exceedingly.

In all these tumours the decomposed cord elongates and spreads: but after cure, when the disease is not of long standing, it gradually re-assumes the natural dimensions. When an individual, already suffering from scrotal hernia, is attacked by vaginal hydrocele, the hernial sac always touches the cyst, sometimes superiorly, sometimes at its circumference. In such cases, these two sacs, separated merely by the proper tunic of the cord, that is, by the cellular layer, the hernia with a portion of its sac, would enter the testiculary membrane, were it ruptured. Should the hernial sac at the same time give way, the viscera alone would enter the tunica vaginalis, and there be constricted. Dupuytren appears frequently to have met with this, and M. Berard the elder has also communicated an example. If the hernia were internal, a serious error might result; mistaking it for congenital, which is always external, the surgeon would cut outwards, whilst, in fact, the neck of the tumour being internal, the epigastric artery would be wounded.

SECTION SECOND.

PERINÆUM.

Bounded, anteriorly, by the root of the scrotum, posteriorly by the apex of the coccyx, and, laterally, by the ischiatic prominences, the *perinæum* comprehends the whole of the parts enclosed within the inferior opening of the pelvis. Its form is oval, the larger extremity directed backwards, and not lozenge-shaped, as considered by Dupuytren. Externally and anteriorly, it presents, in the median line, an elongated eminence, corresponding to the urethra, behind this the anus, and still more posteriorly, the coccygeal prominence. On the sides of the urethral eminence, and bounded externally by the ischia, we find two fossæ, at the bottom of which it is always possible to feel the internal pudic arteries.

The anus is in the centre of an excavation, limited by the buttocks and ischiatic tuberosities. A line drawn, transversely,

from one tuber ischii to the other separates the perinæal from the anal region, circumscribing an anterior triangle, of which it forms the base. The sides of this triangle, being slightly convex, prolong and contract the apex. They are about three inches and a half in length, whilst the base is scarcely three inches. Another line drawn from the summit of this space to the anus would equally be three inches.

The perinæum then presents two perfectly equal triangles, by one of which we must penetrate in the lateral operation for lithotomy.

To distinguish these various peculiarities, the thighs should be separated and flexed upon the pelvis; otherwise there is merely a simple fissure between the buttocks, at the bottom of which is the anal opening and the root of the penis and scrotum. In the fœtus, during accouchement, for example, it is transformed into so narrow a furrow, from the pressure experienced by the buttocks, during their passage through the upper opening, that many practitioners have mistaken it for the sagittal suture.

The *skin*, anteriorly, presents the same characters as that of the scrotum. On the sides and posteriorly, it gradually thickens, and is continuous with that of the buttocks or thighs. Towards the anus, it becomes extremely thin, and covered with wrinkles, having this opening for a centre. It is invested with a quantity of hair in man, and encloses follicles, less prominent than those of the scrotum, but more numerous, especially towards the anus. Their secretion is very abundant, endowing the skin of the perinæum with an oily appearance. Mixed with the secretion from the rectum, it becomes so acrid, in some subjects, as to produce excoriations at the bottom of the fissure already described. These are very painful at the period of defecation, and may be cured by the application of the nitrate of silver. Fine, elastic, and extensible, this membrane is of a more or less deep brown colour.

In front, the subcutaneous tissue, lamellous, and thin over the urethra, enjoys considerable mobility, and is evidently a continuation of the superficial fascia of the scrotum. Hence, infiltrations of urine, pus, &c. occur with great facility in the scrotum, although the seat of mischief may be in the posterior portion of the perinæum. For instance, it happens after lithotomy, and was one of the most frequent accidents after the operations according to the method of Giovani di Romani. Laterally, this layer is thick, less even, and no longer simply lamellous.

Numerous very strong filaments, interlacing in various directions, are met with, as well as adipose cellules; so that it forms, especially backwards, a sort of elastic cushion, of extremely variable thickness. Scarcely existing between the sphincter ani and the integuments, the fleshy fibres are almost in immediate contact with the skin, and suppuration only produces a few

small tubercles; whilst, at the preceding points, large collections are manifested, capable of spreading to a distance with rapidity.

Constituted external to the anus by a considerable mass, continuous with the subcutaneous layer of the buttocks, it proceeds to the front of the gluteus maximus, filling the large triangular excavation, which we shall presently observe, between the external surface of the levator ani muscle, and the corresponding surface of the obturator internus. Here, particularly, it encloses fat, in the form of soft reddish cellules, and its lamellæ and filaments are blended in all directions, producing great elasticity. Its constituent parts, especially the filamentous, have such intimate relation with the perinæal aponeurosis, that they appear part of the same. This is always the seat of abscesses, whether phlegmonous, or stercoraceous, preceding the formation of fistulæ, and of the urinary abscesses, and infiltrations succeeding the various operations for lithotomy. Extending from one side to the other, passing between the rectum, coccyx, and the posterior prolongation of the sphincter muscle, on the one hand, and, on the other, between the transversus perinæi, the bulb, the membranous portion of the urethra, and the front of the rectum, it allows suppuration, &c. to extend from one side to the other.

Aponeuroses, described by Camper and some of the older anatomists, and, since then, much more minutely by Colles, Carcassonne, and Bouvier, the arrangement of the pelvic fasciæ is very complex, and can only be well understood by those who have frequently studied it on the dead body.

Four laminæ, two for the anal region, two for the proper perinæal, together form the ano-perinæal aponeuroses, without reckoning that of the pelvis. Their adhesions to the interposed tissues, the thinness of the *rectal* portion, and of the superficial perinæal layer, explain the difficulty attending their examination.

The *ischiatic* aponeurosis, and the deep layer of the perinæum, alone offering true fibrous characters, were, on that account, the first discovered. By merely considering the others as more or less condensed cellular or cellulo-fibrous membranes, occasionally very thin, and, as it were, converted into simple cellular tissue, we should form a pretty correct idea of their structure. All being more or less confounded, I shall only isolate them, in speaking of their most distinct points, so far as to render the description as clear as possible.

Ischio-rectal aponeurosis.—In the posterior or anal half of the perinæum, the aponeurosis comprehends, on each side, the rectal and ischiatic portions. The former, applied on the external surface of the levator ani, extends, anteriorly, to the back of the transversalis perinæi muscle, posteriorly to the front of the coccyx, and descends to above the sphincter, where it becomes thinner, terminating in the subcutaneous layer; the latter, investing the perinæal surface of the internal obturator muscle,

continuous, below, with the great sacro-sciatic ligament, and joining the preceding in front, superiorly and posteriorly.

Ischio-rectal fossa.—These two fasciæ thus leave a separation between them,—a very remarkable triangular space. We may say that, leaving the deep angle of the pelvic aponeurosis, of which they are only duplicates, they descend obliquely, the one, externally, towards the ischium, or sacro-ischiatic ligament, the other on the circumference of the anus. Posteriorly, the space dividing them terminates in a cul-de-sac, limited, inferiorly, by the gluteus maximus. Anteriorly, there is another cul-de-sac, limited by the superior surface of the transversalis perinæi muscle. The whole of this excavation, which I propose naming *ischio-rectal*, is always filled with cellulo-adipose tissue. Measured from one wall to the other, below, its greatest diameter is from an inch to fifteen lines; from the summit of one cul-de-sac to the other, two or three inches. The external, or *ischiatic*, division of this aponeurosis is strong. Its fibres fall perpendicularly upon the border of the ligament. At twelve to fifteen lines from the transversalis muscle, the inferior hemorrhoidal artery, and a branch of the internal pudic nerve, pierce it obliquely internally, and slightly anteriorly. The internal pudic artery ramifies in the substance of its external surface.

The *internal* or *rectal* division is much thinner, the fibres interlacing. It is rather cellular than fibrous, and its external surface appears to furnish the greater part of the filaments, intermixed with the fat, vessels, and lamellæ, which completely fill the excavation.

Perinæal aponeurosis.—Arrived in the anterior cul-de-sac of the *ischio-rectal* excavations, in front of the anus, the preceding aponeurosis becomes horizontal, takes the name of perinæal, and appears double.

Superficial or *inferior layer.*—The first of its divisions, which may be called *ano-perinæal*, immediately descends beneath the inferior border of the transverse muscle, investing the whole of its internal surface, those of the other muscles of the penis, and the bottom of the space which separates them.

Thus, representing a thin membrane, spread over the inferior surface of the muscles of the perinæum, bulb of the urethra, and crura of the penis, furnishing them with three sheaths, which unite in front to envelope the penis, fixed, on each side, to the ascending branches of the ischium, and descending of the pubes, it is insensibly lost in front on the body of the penis, and continues, posteriorly, with the ischio-rectal aponeurosis, particularly the ischiatic portion. We must be careful not to confound this with the subcutaneous layer, or the general superficial fascia.

Deep layer, (*triangular ligament.*)—Continuing, in front, above the transverse muscles, bulb of the urethra, and corpora cavernosa, as far as the summit of the pubic arch, the second fold of

the perinæal aponeurosis is united to the concave border of the sub-pubic ligament, and seems lost in the fibrous tissue immediately investing the bone and symphysis. Attached to the internal margin of the arch of the pubes, which it completely closes, consequently becoming triangular in shape, this membrane, which we may call *ano-pubian*, is perforated by the urethra, which it embraces in the same manner as we found the ischio-rectal; pierced, as it were, by the anal extremity of the rectum. Very irregular, and very adherent to the parts separating it from the superficial aponeurosis, of an elastic yellowish tissue where it is traversed by the urethra, in front of the prostate gland, which it confines in the pelvis, it is continuous with the species of fibrous sheath enveloping this organ.

Described by Colles, under the name of *triangular ligament of the urethra*, and by M. Carcassonne, by that of *perinæal ligament*, the ano-pubian aponeurosis forms a septum, closing the inferior outlet of the pelvis at its anterior half; so that pus and other matters accumulated in front of the bladder cannot arrive at the perinæum, or, at all events, only with the greatest difficulty.

Being continuous with the external division of the *ischio-rectal* aponeurosis, the superior branch of the pubic artery continues its march between its laminæ. It appears destined to sustain the commencement of the urethra, and to resist the pressure of the viscera, whilst the rectum is sustained, especially, by the ischio-rectal aponeurosis; sufficiently strong, in some individuals, to prevent the hand from being introduced into this intestine.

The ano-pubian aponeurosis being separated from the superior or vesical portion of the pelvic, by the prostate, a part of the urethra and neck of the bladder, the levator ani, and, in front, by cellular tissue and vessels, it is between it and the latter membrane that we must enter the bladder and urethra, in perinæal lithotomy. The *ano-penial* aponeurosis, which is merely a process of the above, is prolonged from it by the perinæal muscles, the bulbous portion of the urethra, and the commencement of the penis. Thus they are confounded at the bottom of the bulbo-cavernous triangle; whence it follows, that the bulb of the urethra and its muscle are contained in a sort of cavity or sheath, not communicating with that of the crura penis, and that infiltration, inflammation, and suppuration may be established in each of these spaces, either individually, or collectively, as in the aponeurotic investments of the limbs.

We ought now to be able to understand a part of the phenomena accompanying or following fistulæ in ano, and several accidents in the operation for lithotomy.

In the first place, acute phlegmonous inflammation, invading the cellulo-adipose tissue filling the ischio-rectal excavation, will there form a large abscess, having no other limits than those of the cavity. Even, when there is a corresponding opening

in the skin, it will continue with equal obstinacy. Its external wall being immoveable, the internal alternately approaches and separates from it, according as the rectum is full or empty, so that they never remain in contact. Hence, it results, that external blind fistulæ may, and frequently do, occur; but they require, in general, the same treatment as perfect fistulæ.

Secondly, after the lateral operation for lithotomy, it is in the ischio-rectal cavity that the urine may become infiltrated, producing dangerous inflammations. However, whether in the lateral or bilateral operation, this mostly occurs when the incision has been carried very far backwards.

Although the perinæal aponeurosis does not extend as far as the anterior surface of the rectum, it is, nevertheless, with difficulty avoided in lithotomy. Thus, abscesses spread towards the side of the scrotum, not between the two fasciæ, as M. Blandin considers, at least, in most instances, inasmuch as the ano-penial is nearly always itself divided beyond, at its posterior limits; but, rather, by means of the subcutaneous tissue, which, firm, areolar, and filamentous, posteriorly, is lamellous, and much more supple, in front. The middle operation alone makes an exception, because it is performed at a point where the two aponeuroses are most separated; this would also be avoided in the methods both of Guerin and Vacca, as these surgeons cut as far as the anus, instead of making an oblique incision from before backwards.

As it is the membranous portion of the urethra, which is embraced by the ano-pubian aponeurosis, this fascia must be divided, in all operations for urethral lithotomy, in such a manner that one half of the incision is above and the other below. Hence, in the first place, infiltration takes place between the pelvic and ano-pubian aponeuroses; in the second, in the ischio-rectal excavation, between the pubic and penial portion of the perinæal aponeurosis: or, rather, beneath the skin, because, in fact, the division extends, at the same time, through the anterior margin of the anal, and the point of division of the perinæal lamellæ.

Perforations of the urethra, in their turn, produce phenomena, varying with their relations to the aponeuroses. In the commencement of the membranous portion, and in the prostatic region, the infiltration extends, at first, towards the side of the pelvis, in consequence of the resistance which it meets with below, and, subsequently, reaches the ischio-rectal excavation, or the cellulo-adipose tissue of the perinusem and scrotum. More anteriorly, it may tend towards the anus, the coccyx, or ischium, because the division of the anterior fibrous layers has scarcely taken place. But when the perforation occurs at the root of the bulb, the urine always runs along the exterior of the urethra and side of the penis, in consequence of the separation of the aponeuroses, and the elasticity and thinness of the tissues in this

direction. Thus, the course pursued by inflammation, or suppuration, indicates the situation of the opening in the urethra.

I have frequently remarked, that, confined between these two fasciæ, the inflammation and suppuration, proceeding with a certain degree of sluggishness, may advance as far as the glans, and along the division of the penis, traversing the scrotum in the form of a cylinder, without implicating the subcutaneous tissue; whilst, when once the superficial fascia is ruptured, the scrotum and rest of the integuments immediately become extremely swollen, as when the mischief commenced in the cellulo-adipose layer. Inflammation of the former character, consequently, indicates disease of the bulbous or spongy portions of the urethra, whilst, from that of the latter, we may, where it occurs primitively, announce lesion of the membranous or prostatic portions.

Muscles.—The *external sphincter* of the anus is the most superficial. Sometimes very thick, at others scarcely distinct, it is always attached by means of a fibrous prolongation to the apex of the coccyx. Anteriorly, it gradually becomes thinner. Its fibres are paler as they extend between the skin and accelerator urinæ muscle, or superficial aponeurosis, and are finally lost beneath the urethra. It, most frequently, terminates thus; but I have, several times, seen it distinctly prolonged in the subcutaneous tissue, as far as the root of the scrotum, evidently becoming continuous with the dartos. M. Rigaud has observed it terminating partly on the transverse muscle, and partly on the tuberosities of the ischium.

When we carefully dissect the sphincter, we find that it is composed of two orders of fibres. The one, forming complete and regular circles, are applied immediately on the external surface of the intestine, or its mucous membrane. The other, united at right angles, in front and behind, are separated into two fasciculi, by the orifice of the rectum.

The first merit the name of internal sphincter. A continuation of the muscular coat of the rectum, they are alone capable of completely closing the opening, and cause the concentric cutaneous wrinkles in its neighbourhood, at the same time preserving its annular form. The second, producing the *proper external sphincter*, can only circumscribe an elliptic opening, and would reduce the anus to a more or less elongated fissure, did not the circular fibres modify their action.

The recent dissections of MM. Thomson and Rigaud have proved that there is a fleshy fasciculus, situated beween the levator ani and external sphincter, described by Santorini, and which is, most likely, the internal sphincter of the ancients. Extending from the posterior margin of the central aponeurosis, to interlace in front of, subsequently behind, the rectum, and to terminate at the coccyx and sciatic ligaments, the two fasciculi

of this muscle are, as it were, traversed by the inferior extremity of the longitudinal fibres of the rectum.

The *accelerator urinæ* appears to succeed the preceding. Embracing the whole of the bulbous, and part of the spongy portions of the urethra, its fibres, taking their fixed point in the fissure separating this canal from the cavernous bodies on the one hand, and from the front of the rectum on the other, may flatten the urethra, and either retain the urine, or force it forwards, according as it is advanced in the canal. Several practical facts lead me to consider that, during catheterism, this muscle may, by spasmodic contraction, momentarily oppose the passage of the instrument. Hence we may explain some of those cases in which the instrument, arrested for an instant by an insurmountable obstacle, penetrates, some minutes later, with the greatest facility. It is, as we have already said, prolonged as far as the anterior surface of the rectum, above the sphincter, where it is irregular, and, as it were, lost with the superficial aponeurosis in the fibro-cellular tissue, situated between the membranous portion of the urethra and the intestine. In lithotomy, according to the method of Mariano Santo, it is commonly divided, on the median line, into two nearly equal portions. In the lateral operation it is only cut on one side, and then parallel to its fibres. In the lateral operation of Foubert, it is not even touched. In following the process of Celsus or Dupuytren, we completely divide its posterior portion. In the recto-vesical operation, it is only cut on the median line, in its fourth part nearest the rectum. Finally, it is separated from the skin, merely by the superficial layer of the perinæal aponeurosis and subcutaneous tissue. The urethra alone prevents its lying upon the ano-pubian division of the same aponeurosis, to which, however, it is attached by the external extremity of its fibres.*

M. Rigaud describes, in addition, a proper muscle of the bulb or *bulbo-rectal*, placed above the preceding and external sphincter, and beneath Santorini's muscle. This is a small fasciculus, of not more than from two or three lines in diameter.

Erectores penis.—Applied on the root of the cavernous bodies, like the preceding, over the bulb of the urethra, equally in relation with the two layers of aponeurosis, the erector penis (*ischio-caverneux*) is separated from the acceleratores urinæ by a triangular space, having its base directed backwards, and at the bottom of which the two laminæ of the aponeurosis are confounded.

It is not in the middle of this triangle, which I shall call *bulbo-cavernous*, that the incision is made in the lateral operation, as it is too frequently said to be. It is only required to be traversed, in the lateral operation, according to the methods of Foubert,

* The reader may obtain a more exact account of these muscles in Mr. Guthrie's work, on the diseases of the bladder and urethra, pages 50, 51.—H. H.

Le Dran, and Thomas, unless it were necessary to cut through its borders to reach the bladder; and then, it is probable, that we should more frequently penetrate by the ischio-rectal excavation. In fact, one of its sides, formed by the cavernous body, and the pubio-ischiatic ramus, is oblique from above downwards, and from within outwards. The other, represented by the spongy and bulbous portions of the urethra, is parallel to the median line, and does not extend as far as the anus. In all the lateral operations for lithotomy, we endeavour to cut the urethra only between the bulb and the rectum, and then obliquely outwards, from the termination of the membranous portion, in front, to the point corresponding to the tuberosities of the ischium. Consequently, instead of following the middle line of this triangle, the instrument merely obliquely crosses its base. Whenever the urethra is opened for the extraction of a calculus, by whatever modification we operate, the erector penis muscle may and ought to be avoided.

The *transversus-perinei* constitutes, precisely, the base of this triangular space. Forming a horizontal plane, leaving the internal lip of the ischium above the crura penis, and running towards the median line, it unites with the corresponding muscle of the opposite side, and the origin of the accelerator urinæ, between the bulb and rectum, and above the cutaneous sphincter of the anus. Its fibres, strong, tense, are, as it were, blended with those of the aponeurosis; the superficial layer of which, sometimes, forms a very distinct band on its posterior border and inferior surface. It is obliquely divided from before backwards, and within outwards, towards its middle portion, in the various lateral operations, even in bilateral lithotomy; in fact, since one or both of these incisions always commence in front, they must necessarily incline backwards, more or less, crossing its fibres. We only avoid it in the major apparatus, supposing that the incision of the external soft parts terminated an inch anterior to the anus.

The *levatores ani* (*ischio-coccygien*) merely enter into the ano-perinæal region by their inferior portions, the fibres of which descend, so as to unite, by a kind of raphé, between the coccyx and the rectum, above the posterior extremity of the sphincter, and, in front, between the same intestine and the urethra, above the transversalis, with which they unite. Thus united, these muscles form a sort of membrane or fleshy pouch, the bottom of which is pierced by the rectum, and the exterior surface invested by the internal fold of the ischio-rectal aponeurosis. Closing the pelvis in the anal portion of the perinæum, there constituting a septum, which opposes the abdominal muscles, they act upon the anus, dilating and raising it, so as to counterbalance and even overcome the action of the sphincter.

In the recto-vesical operation, their anterior union is constantly divided; in other methods they should always be pre-

served. Sometimes, indeed very frequently, the rectum is so large and flaccid, that, unless the knife be inclined considerably outwards, we must wound them, and, what is still worse, at the same time, cut the intestine. In the operation for fistula in ano, where the mischief extends very high up, they are more or less divided, but generally parallel to their fibres. After cure, their action does not appear injured by this solution of continuity.

The arteries are all derived from the internal pudic, excepting those which the rectum receives from the inferior mesenteric, and hemorrhoidal branches of the internal iliac. The latter will be studied with the intestine. We shall here only consider the former and its branches.

The internal pudic only enters the perinæal region after it has emerged from the space separating the two sacro-sciatic ligaments. There enclosed, between the falciform prolongation of the great ligament, and the tuberosity of the ischium, the border of the gluteus maximus separates it from the integuments, placing it at a considerable depth. Nevertheless, Mr. Travers was successful in suspending a serious hemorrhage, which had resisted all other methods, by compressing it against the ischium or on the ischiatic spine. Strictly speaking, it would, also, be possible to tie it at this point, for which it would suffice to incise the skin and subcutaneous layer, by commencing above the base of the coccyx, and terminating on the great trochanter; then, separating the fibres of the gluteus maximus, as far as the sacro-sciatic ligament; dividing the inferior lip of the wound transversely, as far as the same ligament, in order to cut it without being interrupted by muscular contractions. This done, the ligature of the artery is no longer difficult.

Quitting this space, the artery continues on the internal surface of the tuber ischii. At first, simply placed on the pelvic surface of the aponeurosis, this latter, by degrees, envelopes it, and, before arriving at the posterior border of the transverse muscle, it is covered by a complete fibrous canal. Continuing its course above this muscle, and the crus penis, in the ano-pubian aponeurosis, running along the arch of the pubes, as far as the symphysis, it gradually approaches the inferior surface of the fascia, the most superficial layer of which covers it, until it divides into the dorsal and cavernous branehes.

The trunk of the pudic artery, thus fixed by the aponeurosis, through its whole extent, is immobile; remaining in the same position whatever be the attitude and the degree of traction exercised upon the perinæum. Within the ischium, this artery is at a distance of eighteen lines from the anus, and it is scarcely possible to wound it in lithotomy, unless we operate contrary to all rule, and nearer than ordinary to the median line.

To expose it below, we must seek it at about an inch above

the ischia. Being then nearly half an inch above the point of origin of the cavernous bodies, its depth secures it against the action of the knife, during the incision through the external soft parts.

We must remark, that its relations with the central aponeurosis render it difficult to tie, actual cautery being often the only method promising any chance of success, when it has been opened. Compression would not prevent the blood being effused between the obturator internus, or levator ani muscle, and the aponeurosis. M. Physick, however, who wounded it, in 1794, in his first operation for lithotomy, was able, by means of a curved needle, to pass a ligature around it; M. Roux was no less fortunate; thus demonstrating that Desault's want of success is no law on this point.

This artery gives off three principal branches; the first, the external or inferior hemorrhoidal, separates from the trunk, piercing the ischiatic fold of the ischio-rectal aponeurosis, twelve or fifteen lines behind the transverse muscle. Entering the ischio-rectal excavation, it runs transversely towards the anus, dividing several times in the cellular mass which fills this space. On quitting the aponeurosis, it is sufficiently large to render wounds dangerous. It cannot be divided in lithotomy, by the lateral or bilateral methods, unless the incision is carried much further backwards than is generally recommended. As, however, it is not very deeply seated, and its direction is slightly oblique, forwards, it might be divided in too close an approach to the rectum, particularly if the incision were three or four inches in extent, and commenced ten or a dozen lines in front of the anus, as recommended by Mr. S. Cooper, according to Hey.

Its ligature would be much less difficult than that of the pudic, and we may easily find it in the cellulo-adipose tissue, which it traverses to reach the circumference of the fundament.

The hemorrhage, which occasionally occurs in fistula in ano, arises from this; but is seldom very severe or difficult to restrain. When, however, it arises more in front, very near the transversus perinæi muscle, we should have much difficulty in avoiding it in lithotomy.

The second, the *superficial artery* of the *perinæum*, is given off by the pudic, at only about six lines behind the transverse muscle, beneath which it runs tortuously to the subcutaneous layer, at a distance of two, three, or four lines from the ischio-pubian branch. It thus arrives in the *bulbo-cavernous* triangle, runs along the inner side of the erector penis muscle, and, thus, proceeds, ramifying under the root of the penis, to terminate in the scrotum and dartos. At first as deeply seated as the hemorrhoidal, it becomes very superficial in entering the proper perinæum, and yet more so as it approaches the scrotum. Externally, it gives only one branch of any importance, which

crosses the crus penis to terminate in the thigh. The branches furnished from its internal side are too small to merit attention; nevertheless, they often give off the transverse arteries of the perinæum, and from this commonly arises the hemorrhage in lithotomy. It may be wounded in the lateral operation, when, from fear of injuring the rectum, we approach too near to the ischio-pubian branch; and in the transverse operation for lithotomy, if the incision is made too much in front, or if we are obliged to prolong it much outwards. Being always enclosed in the superficial layer, it may generally be secured without difficulty in the posterior portion of the external lip of the wound.

The third, the *transversus perinæi*, generally arises from the pudic, near the posterior border and external extremity of the muscle of the same name. Traversing this border from its superior towards its inferior surface, at first deep-seated, it becomes superficial before it terminates. It is directed transversely, or a little obliquely forwards. Before arriving at the median line, it divides into three principal branches; one proceeding towards the anus, another between the rectum and bulb of the urethra, the third into the bulb itself. They all anastomose with those of the opposite side, precisely at the point traversed by the instrument in lithotomy. Notwithstanding all precautions, their trunk is often injured, even in the bilateral process, because, to avoid the rectum, we commence the incision very near the bulb, and the knife is frequently conducted backwards, and not quite in a transverse direction. The commencement of the wound being thus in front of the termination of the artery, and its posterior extremity behind, this vessel is almost necessarily divided. The rules for its avoidance are certainly useless.

When the transverse artery of the perinæum escapes being wounded in lithotomy, it is by chance, or from some unusual disposition. If this operation is rarely accompanied by serious hemorrhage, this arises from the artery being of insufficient size to prevent the flow of blood from stopping spontaneously, or to require any very great attention. Situated between the two layers of the aponeurosis proper to the perinæum, it is not easily tied, but its compression does not entail the same danger as that of the pudic.

In cases of necessity, however, it is possible to avoid this vessel, the principal branch of which supplies the bulb only; but then, as the external incision must not be commenced at more than six lines in front of the anus, we should, thus, run the risk of wounding the rectum, merely for the sake of preserving a small artery, of too little importance for its injury to be placed in comparison with that of the intestine. When it is double, each of its branches, being still smaller than ordinary, cannot embarrass the surgeon. If it should arise from the pudic beneath

the sciatic ligament, as M. Belmas has observed, its direction, parallel to the superficial perineal, would expose it to the same risks in operations. In a preparation belonging to M. Denonvilliers, it arises from the obturator, winds round the descending ramus of the pubes, and assumes its proper situation in the perinæum. The hemorrhage produced by lithotomy would rarely be serious, if it arose from no other cause than lesion of the transverse, superficial, or hemorrhoidal arteries. If it occasionally becomes alarming, it must rather be attributed to the existence of anormal branches surrounding the prostate.

Veins.—There are two for the internal pudic artery, as well as for each of its principal branches. In old men, and most of those suffering from calculi, they become very large, forming almost a plexus in the perinæal region. They are directed like the arteries above which they lie, whilst in the pelvis they are below; they enter the pelvis by the ischiatic notch. There are others which, approaching the rectum, interlace between the fleshy fibres and the mucous membrane of this intestine, to form a species of erectile tissue, in which hemorrhoids are developed. Others, also, form a plexus around the prostate, sometimes sufficiently rich for a simple incision of this gland to be succeeded by profuse hemorrhage. In those cases, where these various veins are affected by varicose dilatation, which not unfrequently occurs, they are generally the cause of considerable embarrassment in most of the operations performed in the perinæum.

Lymphatics.—This system is not of any importance. There are no known glands, and the vessels pass into the groin or pelvis.

Nerves.—The internal branches of the lesser sciatic and internal pudic are the only ones meriting any attention. The first, which winds out of the sciatic notch, over the internal surface of the tuber ischii, always enclosed in the subcutaneous tissue, is very frequently implicated in the incision of the external soft parts, in transverse or lateral lithotomy. The second, accompanying the artery, is enclosed in the same sheath, divides like it, and runs to the same parts; so that, in applying a ligature upon the divided vessel, it is very difficult to avoid the nerve.

Urethra.—Extending from the neck of the bladder to the extremity of the penis, the urethra is, according to Wathely and Duchamp, about nine inches long. Having seen that it may reach eleven inches, I do not understand upon what foundation Malgaigne could maintain that it is rarely more than six. The researches which I have since made, permit me to affirm that its dimensions vary from five to ten. He may, therefore, be right to a certain extent, and for the following reasons.

Length.—Detached from the pelvis, the urethra is about ten inches long. In its situation, and loosely, upon a catheter, on the contrary, it is only from five to six. In its proper situation,

and extended upon the instrument, it is from eight to nine and a half. I assured myself of these various dimensions upon a great many subjects. This remark is the more important, inasmuch as upon the living subject the catheter is necessarily introduced, when the urethra is in its proper situation, and in a state of relaxation. Hence, at six inches, we are in the bladder, and all cauterisation beyond five is, therefore, useless. This is the most important organ of the perinæum, whether as regards its diseases, or the frequent operations required to be performed upon it.

Curves.—J. L. Petit has observed, that in *prolapsus* of the penis, the urethra offers a very marked double curvature, and he, hence, constructed a sound in the form of S. Of its curves, one, concave, superiorly, lies beneath the symphysis, and the other, concave below, exists in front of that articulation. This latter disappears during erection. We may, by drawing upon the penis, efface that which is posterior. This posterior curve, which has improperly been denied of later days, is not, however, sufficiently established to prevent straight sounds penetrating to the bladder.

Four portions are enumerated in the urethra; the *prostatic*, *membranous*, *bulbous*, and *spongy*.

The *prostatic portion* being enveloped by the prostate gland, we must here examine that organ.

The *prostate* has the form of a flattened cone on its posterior surface, with its apex directed forwards.

Dimensions and relations.—Very small in childhood, it enlarges with age. From eighteen to five-and-twenty, it is two lines less than at forty. In old age, and among persons suffering from disease of the bladder, it is sometimes much larger. Its dimensions should be carefully examined, and cannot be too exactly ascertained before performing lithotomy. From behind forwards, or from the base to its summit, its greatest diameter is from nine to fifteen lines. Measured in the same direction, at various heights, its length gradually diminishes, and quite superiorly, it is not more than four or five. Cutting perpendicularly near its base, and across, it is from eight to twelve lines. We must observe, that the circumference is not exactly circular, and the urethra does not pass through its centre. In order to have essentially practical dimensions, we must draw several lines from the urethra to the principal points of the circumference of the gland. The inferior is from three to six lines, and seldom more; directly across five to eight, and from eight to ten beneath and externally, which is the direction the instrument should take in the lateral operation for lithotomy.

The inferior or posterior surface of the prostate is flattened. Reposing on the anterior of the rectum, two or three inches above the anus, from which it is separated by a thin layer of

cellulo-fibrous tissue, never containing fat, it is difficult to avoid wounding it in the recto-vesical operation.

The pubic surface is six or eight lines from the symphysis, and its lateral portions are about the same distance from the ischio-pubian branches. It is enveloped by a layer, of more or less distinct fleshy appearance, confounded, as it were, with its proper tissue, the direction of the fibres being longitudinal. I have frequently traced these fibres to the bladder, on which they appear to me to depend.* Existing, sometimes, only above the urethra, they have led to the opinion that the prostate is not pierced by this canal, but simply receives it in a groove. This disposition is sometimes met with; but it is an exception, for, as my own dissections prove, without doubt, in most subjects, the prostate forms a complete circle round the urethra. We may say, that the contrary never occurs oftener than once in ten. Although the urethra traverses the prostate much nearer its superior than inferior surface, we, sometimes, remark the contrary. MM. Tanchou and Denonvilliers have each of them mentioned a case, in which the urethra was wholly below, and I have twice seen it separated from the intestine, merely by about two lines of gland. The rectum is then avoided with difficulty, excepting in the transverse operation.

Wilson's muscles.—Besides this fleshy envelope, the prostate receives two small muscular fasciculi on its superior surface, which, detached from the levatores ani, behind the symphysis pubis, descend, nearly perpendicularly, on the commencement of the membranous portion of the urethra. Varying in strength, they are known as *Wilson's muscles*, of which I will give the description forwarded to me by M. Denonvilliers, as best agreeing with what I myself have observed.

This muscle is rarely sufficiently distinct to have any exact form assigned it. In most subjects it is a fleshy mass, placed around the membranous portion of the urethra, extending to the prostate posteriorly, and to the rectum inferiorly. In robust subjects, it presents three orders of fibres; some, immediately connected to the artery, arise from the pubio-prostatic aponeurosis, from the small fibrous arches sustaining the dorsal veins of the penis, and from the posterior of the sub-pubic ligaments. Thence they descend on the sides of the urethra, and unite in a raphé under this canal. The others, quite anterior, arise from the symphysis pubis, forming a tolerably thick elongated fasciculus on each side, directed obliquely downwards and backwards, towards the rectum, where it is placed upon the superior surface of the ano-pubian aponeurosis. United to its

* I have, also, often traced the longitudinal fibres of the muscular coat of the bladder to the superior surface of the prostate gland, into which they appear to be inserted. In one instance I observed them to terminate at the verumontanum, having pierced the gland.—H. H.

fellow, above and below, it separates from it in the centre, for the passage of the urethra; the two fasciculi thus representing a sort of sphincter around the membranous portion. Numerous fibres, commencing from the ano-pubian aponeurosis, proceed, partly below, to unite with those of the opposite side; partly outwards, to spread in a large flattened bundle, on the sides of the prostate.

Thus, the muscle has three portions, the first urethral, the second rectal, described by Wilson, and the third prostatic. This compound muscle is always distinct from the levator ani, from which it is separated by the lateral aponeurosis of the prostate, and from the accelerator urinæ, placed in front of Camper's ligament.

M. Rigaud, who also traces it from the back of the symphysis pubis, thinks that he has observed a branch, on either side, to the tuberosities of the ischium, so that this muscle might also be a dilator of the urethra. *

Aponeurosis.—The prostate, is next, almost completely covered by a fibrous envelope, continuous, on the one hand, with the pelvic, and, on the other, with the perinæal aponeurosis. This *aponeurosis* has been very minutely studied by M. Denonvilliers, who has named it the *lateral aponeurosis of the prostate*, and describes it as follows:—

" Thick, resistant, of a fibro-cellular texture, it extends from " the sides of the symphysis pubis, where it is attached, as far " as the rectum, on the sides of which it is prolonged in the " form of a cellular layer, placed between the proper fibres of " this intestine and those of the levator ani. From above " downwards, it extends between the superior perinæal aponeu- " rosis of the *fascia pelvica* and the ano-pubian aponeurosis. " Inserted on the former, it thence descends, perpendicularly, " on the latter, then changes its direction, becomes horizontal, " mingles, by its inferior surface, with Camper's ligament, and

* If M. Velpeau had turned to page 40 of Mr. Guthrie's work on the diseases of the bladder and urethra, he would have found the following description of these branches, discovered by that gentleman in the year 1833, preparations of which are placed in the Museum at the Ophthalmic Hospital. " On the upper part, there is " a central median line of tendon, which runs backwards, to be inserted into the " fascia, covering the upper part of the prostate; and, again, forwards, on the urethra, " through the triangular ligament, to be inserted in front of it, near the union of the " corpora cavernosa. On the under part, a similar tendinous line is to be observed, " which is attached, backwards, to the fascia, underneath the apex of the prostate, " and forwards to the central tendinous point in the perinæum. The muscle, on its " upper surface, is covered by fascia, descending from the pubes, which adheres to " it; and this I take to be what Mr. Wilson described as the tendinous origin of " this muscle, and from which he supposed the fibres descended to surround the " urethra, which they really do not. From the middle tendinous line, in the upper " part of the urethra, the fibres pass outwards, on each side, converging towards " the centre, where they form a leg, as I term it, of muscular fibres. On the under " surface the same thing takes place; and a leg, on each side, being thus formed " from the superior and inferior fibres running from each half of the urethra, they " pass outwardly, that is, transversely, across the perinæum, to be inserted into the " ascending ramus of the ischium, a little below its junction with the descending " ramus of the pubes."—H. H.

"by the other is continuous with the inferior border of the "levator ani muscle, which glides upon it without adhering. "Its vertical portion is equally in relation, by its external sur-"face, to the levator ani, which contracts no cellular adhesion "to it. Its internal surface is separated from the membranous "portion of the urethra by Wilson's muscle, and receives the "insertion of a portion of its fibres; it is then placed on the "prostate, to which it is united by dense, compact, cellular "tissue, in the substance of which ramify the veins surrounding "this gland.

"Between these two pubio-prostatic ligaments, there is an "interval of from eight to ten lines, filled by a thin, fibrous, "but resistant, layer, in the form of a funnel, pierced by several "foramina, for the passage of the dorsal veins of the penis to "the venous plexus of the *bas-fond* of the bladder, which may "be termed pubio-prostatic aponeurosis.

"By means of this, Camper's ligament and the lateral apo-"neurosis of the prostate, the membranous portion of the "urethra is confined in a kind of case, irregularly quadrilateral, "everywhere closed, excepting posteriorly, where it is limited "by the prostate. It is also the lateral aponeurosis of the "prostate which completely separates the levator ani from "Wilson's muscle."

External to all this, is the cellular tissue, loose, very abundant on the sides and in front, very dense posteriorly, and on the median line. The existence of this is a very important fact. Its density moderates swelling of the gland in acute inflammation, and causes abscesses to burst more frequently into the urethra, than through the integuments. It also explains how the ulcerated prostate suppurates, or, when grooved by calculi, may be transformed into a large cavity, which may lead to mistakes in catheterism. The instrument, arrived in a free space, gives passage to a certain quantity of urine, and the surgeon then thinks that it is in the bladder. M. Roux and I have met with several such cases.

The *base* of the *prostate* receives the neck of the bladder, where it is joined to the urethra; also the deferential canals, which touch as they plunge into it at the median line. Posteriorly are the *vesiculæ seminales*; in opening the bladder by the rectum, according to the first method of M. Sanson, we almost always divide one of the deferential canals, and, sometimes, the vesicula seminalis itself.

We must here remark that the ejaculatory ducts traverse the prostate from behind forwards, through its whole length.

In some subjects, the posterior border of the prostate is, as it were, formed of three lobes. The middle, in swelling, pushes the neck of the bladder upwards; flattening, and even obliterat-g, it, according to Sir E. Home, who considered this as one of most frequent causes of retention of urine in old people.

With regard to this subject, it must be understood, that the lobe, considered by the latter author as a natural organ, is a morbid production. If it be true that we observe it most frequently behind and on the median line, it is no less so that we meet with it elsewhere. I have counted ten in the same prostate. They are globulous bodies, having some analogy to the fibrous productions of the uterus, and vary no less in form and number than in size. Dense, elastic, the same colour as the gland, they give it a knobby appearance, and may easily be mistaken for its proper tissue. I have seen some with pedicles, and as large as a walnut, closing the neck of the bladder. Projecting into the urethra, rectum, or bladder, according as they have commenced in this or that point of the prostate, we can understand that the difficulty in passing the water arises less from their size and number than from their position.

Be this as it may, the implication of the prostate in lithotomy requires the more attention, as it has only been studied of late years. In this point of view, its form, exact size, relations, and density ought to be correctly ascertained by the surgeon.

The first rule is, never, in any case, to prolong its section beyond its circumference. Where this precaution is neglected, the neck of the bladder is more or less divided. The lips of the wound, being supported neither by the solid tissues around the gland nor by a band of its parenchyma, separate, so that the urine flows into the surrounding parts; in which case there are two results to be dreaded, *urinary fistula*, and inflammation of the cellular tissue surrounding the neck of the bladder.

The latter accident, as formidable as common, causes more deaths than all the others put together, by the extension of the inflammation to the cellular layer between the prostate and rectum, the prostate and pubes, perinæal and pelvic aponeuroses, and prolonged between the peritoneum and bladder, to unite with the fascia propria.

Another circumstance should put the surgeon on his guard, which is, that anormal arteries, of some magnitude, have more than once been met with around the prostate. Haller has mentioned them as well as Winslow; Burns cites three examples; Harrison three others; Tiedeman and Meckel speak of it as a common fact; and I have twice met with it. In the case mentioned by M. Hulme, the anormal branch came from the obturator, furnished by the epigastric, and passed over the side of the prostate to the dorsum of the penis. Thus, in lithotomy, according to Foubert and Thomson, it must have inevitably been divided.

When the anormal artery is derived, in the pelvis, from the ischiatic, pudic, or from the internal iliac itself, it may run along, and even traverse the side of the gland, from below upwards, and behind forwards, in such a manner, that no modification in the lateral operation can avoid it. In a man sixty years of age, (operated upon by Shaw,) who died from hemorrhage, the blood flowed from

a branch of the internal iliac, which passed over the side of the prostate to the penis. It is very probable that the hemorrhage, after lithotomy, more frequently depends upon such anomalies, than upon injury of the trunk or branches of the internal pudic.

The surgeon should, therefore, endeavour to cut the prostate, as freely as possible, without completely exceeding its circumference. By the apparatus major, the incision, it is true, does not extend so far as its posterior portion; but, as the commencement of the urethra is not divided, the vesical opening is necessarily very small, notwithstanding the extent of the wound in the external soft parts. In pursuing the method of Foubert, we avoid the prostate; but, traversing the great ischio-rectal cellular space, we run the risk of the accident of which we have just spoken. By the lateral method, imitating Boyer, that is to say, withdrawing the knife transversely, directing its back against the right ramus of the pubes, to avoid the rectum, on the one hand, and the pudic artery on the other, it would be dangerous to extend the incision beyond ten lines, as the transverse diameter of the gland is only eight. Following Cheselden, on the contrary, as we divide the gland parallel to its largest diameter, that is, obliquely outwards and downwards, it is evident that we might attain two lines more without danger. In this point of view, the oblique lateral method is the best.

By the recto-vesical method, the prostate allows an incision of only eight lines, although a great part of the membranous portion of the urethra be divided; a much smaller opening, in fact, than by the other proceedings, whenever it does not extend to the neck of the bladder. By the method of Dupuytren, we may obtain ten lines on each side, since the two blades of the instrument traverse the longest diameter of the gland. Besides, as this double oblique incision circumscribes a triangular flap, enclosing the ejaculatory ducts, the verumontanum, and the inferior half of the prostatic portion of the urethra, we may perceive that it is possible, strictly speaking, to obtain an opening, above two inches in extent, without serious danger. By Thomson's operation, we have the inconveniences of the lateral method of Foubert; and the urethra, opened above and below, presents two very large slits, without facilitating the issue of foreign bodies, as the upper surface of the gland is alone divided.

The portion of the urethra enclosed in the prostate is funnel-shaped at its point of union with the bladder. A line or two in front, it rather contracts, afterwards it again enlarges, to retract at the commencement of the membranous portion.

The neck of the bladder, long regarded as encircled by a sphincter, has been forgotten by surgeons of the present day. The existence of its mucous fold was generally denied, when it was again brought into notice, relative to catheterism, by the assertion, that, at this point, there exists a true valve, contain-

ing, sometimes, fleshy transverse fibres, and against which the point of the sound frequently strikes. This valvule, called *pyloric*, has no real existence in most people; but the commencement of the urethra is raised here by the posterior border of the prostate; and all its membranes, not yet decomposed, are thicker than elsewhere.

The *excavation* between this contraction and that met with in front, encloses the urethral crest, or *verumontanum*, dividing the inferior wall of the urethra into two equal portions, over which the sound slides before it reaches the bladder. As the mucous membrane is here very thin, and the excavation occasionally deep, it is necessary, to avoid the formation of a false passage, to keep the extremity of the instrument directed upwards. I have frequently observed lacunæ of sufficient size to receive the point of the instrument. M. Cown, of Villards, has a preparation, showing the orifice of a third ureter at this point.

The *verumontanum* is an essential organ, meriting great precaution in catheterism, especially when we introduce caustic into the urethra, inasmuch as its irritation spreads with the greatest rapidity to the testes and vas deferens.

It terminates at ten lines in front of the neck of the bladder, and there forms a sort of tubercle, in the centre of which the ejaculatory ducts open, even if there should only be one, swollen like a blister, of about eight lines in length, as observed by M. Denonvilliers. On either side are the prostatic ducts, arranged in two lines, so as to circumscribe a V, with its apex forwards.

We not unfrequently find this tubercle depressed in its centre, and it has been considered that the extremity of the instrument often catches, causing considerable mischief, from lesion of the seminal ducts. But if this should be the case, the difficulty arises, much more frequently, from the instrument being arrested in the lateral excavations.

Prolonged, posteriorly, to form the *luette*, the *verumontanum* sometimes, by spreading, produces two lateral folds, concave anteriorly, and resembling two indistinct valvules. These may give rise to great difficulty in catheterism. Towards the membranous portion, that is to say, in front, the urethral crest sometimes presents a disposition similar to the preceding, unless it be that the concave border of the fold looks backwards. I have met with three instances, and Langenbeck has already described one in his *Memoire sur la Lithotomie*, in 1802.

The prominence occasionally formed by the crest, or one of the lobes of the prostate posteriorly, considered by Morgagni as anomalous, described by Lieutaud as natural, by the term *luette*, is so much developed in some individuals as to produce complete retention of urine (*ischurie*). Swollen, in the shape of a pear, and a little flattened, as large as a walnut, and

attached to the urethra by a sort of pedicle, as I observed in one case in 1830, and in another in 1836, it may be tied or excised by the instruments invented by M. Leroy. As the catheter can slide past its sides, the tumour may lead to the belief of paralysis, the urine pushing against it rendering it a kind of plug, at the neck of the bladder, whilst it scarcely interferes with the entrance of the instrument. This was the case in those instances which I saw. Hence, the utility of retaining a catheter in the bladders of such patients. When the base is larger than the projecting portion, the ligature and excision are no longer advisable. The redressor, either of M. Pravaz, Tanchou, or Leroy, an instrument which is introduced to the spot, and pushes the tumour towards the rectum by covering its apex, at the same time depressing the neck of the bladder, is then applicable, and it is probably in such cases that it produces the benefits attributed to it.

In the prostatic region, the urethra is generally less extensible below than above. The difference in this respect is especially great among those subjects where the gland does not completely encircle the canal. Its superior, thick, muscular wall then admits of considerable dilatation without being torn. It is also difficult to make a false passage, by conducting the instrument along it, whilst nothing is more frequent at the inferior portion. When the urethra is reduced to its simple elements beneath the pubes, that is to say, when it is deprived of the prostate, its thickness rarely changes superiorly. Its inferior wall, on the contrary, is exceedingly weak in this case, and constituted almost entirely of mucous membrane, invested by a thin layer of cellular tissue.

It appears that this portion of the urethra is merely a pure and simple prolongation of the bladder, between the membranes of which the prostate is developed; thus deriving a sheath from the muscular coat, whilst it is lined internally by the mucous membrane.

The prostatic region of the urethra being raised backwards, by the posterior margin of the prostate, and, as it were, excavated in its middle portion, sounds, &c. arrested by the arch of the pubes do not easily tear it; when they are formed into an arc of a circle prolonged to the point, and not merely curved, as they are generally made. Here, for the same reason, is one of the causes of false passage; but as the surgeon, after having laboured at the prostate, may enter the bladder by perforating the trigone, he does not always perceive this. They are here less dangerous than in the membranous portion, inasmuch as the glandular structure, less predisposed to urinary infiltration than the cellular tissue, quickly closes upon itself, obliterating the wound when the instrument is withdrawn.

From the bladder the urethra is sufficiently large and elastic to allow the extremity of the index finger being introduced,

without rupturing it. We may, therefore, reckon with certainty, in the extraction of calculi, upon five, six, or seven lines of dilatation, at its posterior portion. In infancy its root is more elevated than in the adult, because the bladder, approaching more to the umbilicus, draws it behind the pubes. It is also the same in man, when the rectum is filled with feculant matter, or when, from retention of urine, the bladder is forced through the upper opening of the pelvis into the abdomen. This latter peculiarity, which has hitherto remained unnoticed, is the cause of the difficulties then experienced in entering the bladder. In the natural condition this elevation, and the resulting curvature, are, however, less than might be at first thought; so much so, that they may be partly removed, by stretching the penis. In this manner, the prostate is drawn beneath the arch of the pubes and the posterior portion of the canal, opposite the bas-fond of the bladder, so that an instrument enters with the greatest facility.

All this does not decide, that the prostatic portion of the urethra is not curved, but simply, that it is possible to diminish the curvature, and use straight instruments where the case appears to require it. Every body knows, says M. Amussat, that the urethra in the female is straight, or nearly so; why not, therefore, admit the same thing in man, as the urethra is not more elevated by the prostate, than by the vagina, in the other sex? The comparison is not exact. The pelvis of the male being narrower, the bladder is more raised behind the pubes. On the other hand, the symphysis descending a little lower, the urethra is necessarily more curved in the masculine sex.

Moreover the urethra, in the female, is far from being straight; its shortness alone can deceive upon this point. It has no suspensory ligament in front of the pubes. In those cases where the symphysis measured from twenty-four to twenty-five lines, instead of from eighteen to twenty, as mentioned by M. Leroy, and as I have observed in two instances, this curvature is so marked, that the introduction of a straight sound would be, at all events, very difficult, if not impossible.

We understand, then, from its organisation that the prostatic portion of the urethra cannot contract; that the spasmodic strictures here are absolutely impossible; that it may be contracted or obliterated by the organs surrounding, or by productions in its anterior, but not by thickening of its mucous membrane or subjacent cellular tissue; also, that dilating remedies need never be carried as far, and that the nitrate of silver is only serviceable here as a styptic for excoriations or inflammation, frequently met with. On account of its excavation calculi easily remain, and those of the bladder may be fixed by their apices, whilst their bases remain free in the urinary pouch.

The *membranous portion* of the urethra, from eight to ten lines long, is situated beneath the arch of the pubes, but separated from it by a space of about six lines, filled by cellular or reddish fibro-cellular tissue. This space, traversed in addition by the dorsal veins of the penis, which enter the pelvis to empty themselves in the hypogastric vein, also encloses the corresponding arteries, where they abandon the ischio-pubian ramus, to place themselves upon the dorsum of the penis, whether they unite and form one, or whether they arise from one of the branches of the internal iliac,—the vesical, ischiatic, for example. Inferiorly, the membranous portion seems shorter, from the point of the prostate and bulb appearing to approximate. It is enveloped by a prolongation of the prostatic sheath, which endows it with a much greater degree of strength, than we might at first imagine it to possess. More immediately we find a complete muscular tunic, sometimes strong and distinct, at others, on the contrary, as it were, transformed into yellow tissue, the composition of which is sufficiently remarkable to deserve a moment's consideration. Its external vertical fibres evidently depend upon the spreading of Wilson's muscle, which, taking its fixed point behind the pubes, may draw the urethra upwards, but without compressing it to any great degree.

The deeper seated, parallel to the direction of the canal, appear to be a continuation of those investing the prostate, and to come from the neck of the bladder. As they are crossed by annular fibres, the urethra may be strongly constricted, and oppose the passage of a catheter. This explains the spasmodic contractions experienced by all surgeons, and the facility with which the instrument is occasionally passed, perhaps a moment after its introduction was absolutely impossible.

Cowper's glands, about as large as a pea, enveloped in these fibres, are seen on either side of the urethra, where the membranous portion traverses the central aponeurosis to reach the bulb. Dense and very adherent to the surrounding organs, they are of no importance in surgery.

Internally, the urethra, smaller than in the prostate, widens posteriorly, and in entering the bulbous portion; whence it follows, that foreign bodies pushed through the meatus urinarius are very frequently arrested, and that false passages are often met with here, after forced catheterism. We must remark, that, when the instrument makes a false passage at this point, it may slide beneath the aponeurosis as far as the anal region, and that in this manner the accidental tract is less dangerous, than where the instrument proceeds close to the prostate or neck of the bladder. We may also observe, that the terms *muscular* or *fleshy*, given to this portion of the urethra by the ancients, is, perhaps, more proper than that of membranous. Its great elasticity, and the vitality of its elements,

explain the frequency of its contractions, and the effect of dilating bodies upon it. Inflammations of its villous coat, and subjacent lamellous tissue, being the common cause of these contractions, we may thus understand, how the nitrate of silver, so efficacious in inflammations of mucous membranes in general, has become so favourite a remedy in these affections.

The *bulbous portion*, the origin of the corpus spongiosum urethræ, is particularly remarkable, from the tissue, which distinguishes the latter, being prolonged backwards, beneath the canal, in form of an oval swelling, called *bulb*, which is separated from the skin by the accelerator muscle, and may be felt externally in thin persons.

The urethra and its bulb pursue a different direction. This peculiarity, upon which M. Amussat insists to prove that it is straight, or nearly so, appears to me to prove the contrary. In fact, the bulb is prolonged backwards towards the anus; whilst the urethra, which to be straight ought to follow the same line, quits it so much, that to arrive at the prostatic portion by the perinæum we are obliged to divide parts to the thickness of an inch, an inch and a half, and sometimes more.

The *spongy portion* of the urethra is not separated from the bulbous portion by any line of demarcation. It insensibly decreases as far as the anterior extremity of the cavernous bodies, where it swells to form the glans. Its erectile tissue is much thicker towards the bulb. The fibrous tissue enveloping it being inelastic, the canal is considerably constricted during erection. This portion of the urethra, covered by the skin and the subcutaneous tissue, is so firmly united to the groove in the penis, that some persons have described it as developed between the layers of the fibrous sheath of the corpora cavernosa; but, in reality, these two parts are only united by albugineous filaments, or some vessels which allow fine injections to penetrate in the corpora cavernosa, although introduced by the bulb, and vice versâ.

Internally, the spongy portion of the urethra but slightly contracts from behind forwards. Behind the urinary meatus it sensibly enlarges, and forms the *fossa navicularis*, the existence of which is improperly denied in the present day. It suffices, in fact, to fill the urethra of a subject with wax, to show that it does dilate at this point. On the living we obtain the same result, by leaving a soft bougie in for some minutes. If it be true, that, after death, the tissue of the glans, more dense, maintains the mucous membrane dilated and distended, whilst, posteriorly, the spongy tissue of the urethra contracts upon itself, so as to produce the enlargement of which we speak, it is no less so, that the same thing occurs during life, and the whole argument is reduced to a mere quibble.

The fossa navicularis, like all other dilated portions of the

urethra, exists, particularly, on the inferior wall of this canal, and ordinarily inflames first in gonorrhœa.

The mucous membrane of the urethra is of a slightly rose-coloured white, and wrinkled longitudinally. As these are caused by occasional dilatation of the canal, contracted by its own elasticity when empty, the navicular fossa, not subject to the same changes, presents none. Between these lines are others, less distinct, transverse or semilunar, concave anteriorly, which would form so many valves, were they more marked, and which limit small spaces, known as *lacunæ Morgagni.*

The urethra, extensible to a degree permitting the introduction of a cylinder four or five lines in diameter, quickly re-assumes its primitive calibre after dilatation. Whence the benefits of dilating bougies soon disappear, after they have ceased to be used; and large straight sounds may without inconvenience be carried into the bladder, serving to conduct other intruments to seize, break, or extract calculi.

Anomalies.—When the urethra is not prolonged to the extremity of the penis, the meatus urinarius, arrested on the inferior surface of the organ, at a greater or less distance from the pubes, constitutes *hypospadius.*

We term that *epispadius,* where the meatus is placed on the dorsum of the penis; but this is so rare an anomaly, that the few examples cited leave much to desire, and appear nearly always to depend on exstrophia of the bladder. The absence of the penial portion of the urethra often coincides with a more or less complete fissure of the scrotum, and the retention of the testes behind the ring. The subject then appears to possess a vulva, and the external organs at first sight resemble those of females, in whom the clitoris is exceedingly developed.

In 1829, I saw an individual, aged fifty-five, in this condition, and in 1832 another, aged twenty-eight, and also two newly born infants. The most remarkable instance of all is that which was met with at the Hôpital de la Pitié, in a subject who had died of cholera. Here there was a prostate and a uterus, and at the same time a complete penis. M. Bouillard has published this case, with all its details.

There is no proof of several urethræ having ever been observed in the same individual. It terminated at the glans by two or three openings, in the cases observed by F. de Hilden, Vesale, Haller, M. Vidal de Cassis, and myself; but it was not the less single. It was a false canal, which, arising from the meatus, terminated in a cul-de-sac in front of the anus, in the subject mentioned by Monod. He also met with a similar canal, opening into the rectum, to which it served for an anus. The urethra is subject to many other varieties, an account of which will be found in M. Vidal's Journal.

Neck of the bladder.—By this term is meant the portion of

that bag, extending from the point where the peritoneum leaves it to its entrance in the prostate. Surrounded by a venous plexus, developed by diseases of the bladder, enclosed in supple, elastic, and sometimes very abundant lamellous cellular tissue, the neck of the bladder cannot be incised without danger. Its posterior and inferior portion is the most interesting, and is always called *bas-fond.* It is in relation with the rectum, from which the inguino-seminal and prostato-peritoneal aponeuroses separate it; then a cellular layer, dense on the median line, much thinner laterally. The intestinal and vesical walls, as it were, confounded in the first instance, thus form the *recto-vesical* septum, which is so thin that we can tell through the intestine, by means of the finger, the form of solid bodies enclosed in the bladder. As it encloses no very large vessels, nor other organ of importance, it has been recommended to penetrate by the rectum into the bladder. Flurant thus performed paracentesis in retention of urine, and M. Sanson proposed operating for lithotomy. In both cases, it would be dangerous to carry the instrument more than an inch above the prostate, the peritoneum ordinarily descending thus far, and occasionally lower. Bromfield exceeded the limits of the prostate, in a case of perinæal lithotomy and the intestine entered the wound.

The lateral fissures, resulting from the approximation of the rectum and bladder, enclose adipose cellules, vesiculæ seminales, deferential canals, and the ends of the ureters. These, entering the walls of the bladder externally, and quite superiorly to the bas-fond, are not exposed to injury in the two operations just mentioned.

The vesiculæ seminales, accompanied on their inner sides by the deferential canals, circumscribe a triangle, the apex of which penetrates the posterior border of the prostate, so that, in the recto-vesical operation, the incision approaches the gland: we almost inevitably divide the termination of the deferential canal, and the commencement of the ejaculatory duct. Some surgeons, also, enforce, that after this operation, if the incision is not made even, or if it be too much on one side, the urine will easily escape into the cellular layer, giving rise to fatal mischief. On the other hand, it is well understood that wounds of the neck of the bladder almost always remain fistulous. In fact, its fibres are longitudinal and transverse. The former are most numerous on the sides and in front; the latter predominate below and behind, where they form the *trigone.* Whether the division be made perpendicularly to their axis, as in the lateral operation, or parallel, as in the recto-vesical, these fibres always lead to separation of the wound. As they are, in addition, unsustained by any solid tissues, cicatrisation is difficult, and lithotomy, where the recto-vesical wall is divided, between the prostate and peritoneal fold, separating the perinæum from the pelvis, would be a dangerous operation.

Sometimes, instead of being convex, the bas-fond is concave, representing a kind of gutter in front of the rectum. The enlargement, the destruction of the prostate, its transformation into a purulent pouch, or supplementary bladder, being capable of compressing, closing, or breaking the ejaculatory ducts, the vesiculæ seminales are hypertrophied or atrophied, in persons affected by these complaints; whence incontinence of semen, sterility, &c.

Internally, the neck of the bladder, a sort of funnel, the apex being at the urethra, is formed below by the *trigone*, which principally reposes on the rectum, in the middle, and on the vesiculæ seminales laterally, receiving, by its posterior angles, the termination of the ureters; which, traversing a space of five or six lines between its walls, cause the fluid, secreted by the kidney, to flow easily into the bladder, whilst, when once entered, it cannot return by the urethra, but closes the orifice. The extreme dilatation of the urethra allows the blade of the knife to enter here, and causes embarrassment in catheterism. Numerous vesicular calculi, furnished by the kidney, frequently stop here, though they ultimately escape through the urethra. Beclard has twice operated, on the same patient, for such a disease, which is frequently met with. The stone cannot then be moved. The trigone vesical, and the whole of the bas-fond, are ordinarily on a plane, inferior to that occupying the commencement of the urethra. In some individuals, it forms a sufficiently complete band to hide the calculi, so much so that Souberbielle was forced to divide it to terminate the operation. This excavation, in children, is very superficial or does not exist. The accumulation of feculant matter in the rectum also causes it to disappear.

In very fat persons it is almost impossible, or, at least, very dangerous, to puncture through the rectum, the bladder being, as it were, forced above the pubes by the fat surrounding it. The *urethral crest*, or *luette*, is situated at the point of union, between the neck of the bladder and the urethra, as is also the sphincter of the same name, when it exits.

Anus.—From the point where the peritoneum invests it in the pelvis, the rectum descends obliquely forwards, between the sacrum and bas-fond of the bladder, as far as the prostate. Turning slightly backwards, to terminate at the anus, it presents a decided curve, the convexity of which corresponds to the posterior surface of the prostate, whilst its concavity embraces the apex of the coccyx.

In consequence of this curve, when we would administer an enema, or introduce any foreign substance into the intestine, we must, at first, follow an oblique direction from below upwards, and forwards; subsequently, upwards and backwards.

It is from the want of knowledge, upon this point, that nurses, &c. occasionally have so much trouble in administering enemata, and that they wound and tear the parts, running the risk of per-

forating the peritoneum and bladder in front, or pushing the instrument into the cellular tissue of the meso-rectum behind, as I have seen upon three several occasions.

Recto-urethral triangle.—Inclining thus at its anal extremity, the rectum leaves a space between its anterior surface and the bulb of the urethra, which is always traversed by the instruments in lithotomy. Formed, superiorly and anteriorly, by the apex of the prostate, the membranous and bulbous portions of the urethra, posteriorly by the front of the intestine, from the prostate as far as the anus, and below by the skin forming its base, this space encloses, from the skin towards the urethra, cellular tissue, termination of the external sphincter muscle, the commencement of the acceleratores urinæ, and M. Rigaud's muscles, transversalis perinæi, termination of the bulbo-urethral artery, Santorini's muscle, or some fibres of the levator ani, dense and compact cellular tissue, the base of the middle aponeuroses, and all the membranous portion of the urethra. Its posterior plane being inclined towards the coccyx, we may understand the danger of making the incision, in lithotomy, at less than an inch in front of the anus; as we should then, especially if we operate according to Celsus, rarely fail to open the rectum before we arrived at the prostate.

This accident may be dreaded more particularly in those individuals in whom the intestine is very much dilated immediately above the sphincter. I understand that Dupuytren's method was once followed by this inconvenience. When, on the contrary, the anus is pushed less backwards, the rectum is nearly always concave anteriorly, as in infants, and we then penetrate to the bladder without danger. It is under these circumstances that Cheselden's or Dubois' knife might be advantageously employed.

The *folds of the anus*, at the bottom of which M. Rigaud has found follicles, ranged like the meibomian glands, disappearing during defecation, may be torn by forced dilatation, and conceal cracks and excoriations. Irritated by friction, and the acridity or prolonged contact of the fæces, it is evident that these *fissures* cause great pain at each evacuation, and that the division of the sphincter, which relaxes the parts, is the best remedy; that the nitrate of silver, which covers them with a kind of crust, also cures them occasionally; and that simple, dilating bougies, by removing all acrid substances, at the same time that they render the passage more free, are equally successful, in some cases.

Above the prostate, the rectum is separated from the bladder, vesiculæ seminales, and deferential canals, by a thin layer of cellular tissue, and afterwards by a kind of aponeurosis, described by M. Denonvilliers.

Prostato-peritoneal aponeurosis.—This is confounded on both sides with the dense cellular tissue surrounding the venous plexus of the bas-fond. It is lost, by its inferior border, on the

posterior extremity of the prostate; it adheres, by its superior edge, to that portion of the peritoneum which descends between the rectum and bladder. This adherence, as intimate as if effected by a blending of tissue, explains the consistency of the recto-vesical cul-de-sac of the peritoneum. The surface touching the rectum scarcely adheres to it by loose cellular tissue. On the contrary, dense cellular prolongations are given off from its anterior surface, to envelope the vesiculæ seminales.

The texture of this layer resembles that of the dartos, and appears formed principally of fibrillæ, radiating from the inferior surface of the peritoneum, and much more marked at the median line. In robust individuals we may find muscular fibres, but only towards the sides.

This membrane is very strong, and, with the bas-fond of the bladder, forms a space, closed at all points, in which are contained the vesiculæ seminales, a portion of the urethra, and the deferential canal. These latter enter this cavity through the dense cellular tissue, forming its lateral walls. They are, moreover, surrounded by the fibres, traced by M. Thomson from the internal border of the internal inguinal ring, and which, spreading like a fan behind the vesiculæ seminales, appear to me to mingle and terminate with the preceding aponeurosis, and with that which Denonvilliers calls lateral fascia of the prostate.

Dilating, beyond measure, in habitually costive individuals, particularly old persons, instead of being rounded on its anterior surface, the rectum presents a sort of fossa for the prostate, above the anus. As it then ascends more or less on each side, it is difficult, in the lateral or even transverse operation, to avoid it, inasmuch as it commonly projects most to the left. The rectum occasionally falls completely on this side of the pelvis, and as frequently, in other instances, inclines to the right.

Stercoraceous abscesses, happily, are but rarely manifested in front, as, if we would operate for fistulæ in this direction, the urethra, neck of the bladder, vesiculæ seminales, deferential canals, and large arteries would all run the risk of being wounded.

Posteriorly and laterally, the rectum is separated from the coccyx and muscles by very strong elastic cellular tissue, traversed by branches of the middle sacral artery, nervous filaments from the sacral plexus, &c. Hence phlegmonous inflammation may occur here, and extend with greater facility towards the abdomen than perinæum. It contracts, internally, in traversing the ischio-rectal aponeurosis and sphincter, so that, in most individuals, when healthy, we are obliged to use some degree of force in introducing the finger. Besides, there exist rudiments of *valves* at this point, described, in the first instance, by Houston, and bearing some analogy to the pylorus. As some of the contractions of the anus depend upon these, they would be advantageously treated by incision. In consequence of the

slight dilatation observed beneath, the veins, compressed between the fibres of the sphincter, frequently produce hemorrhoids, and give rise to the commencement of fistulæ. Above, the intestine is so large, that to compress from within outwards, in cases of hemorrhage, solid bodies are quite insufficient, and, in their stead, we are obliged to use lint, or distended bags; thus the pressure quickly causes considerable mischief to the bladder and pelvic vessels.

The finger, bent like a hook, may, if necessary, draw the anus outwards, and assist materially in the extirpation of cancer. It also results that foreign bodies, such as phials, &c. introduced into the rectum, cannot be removed without great difficulty. A chicken's bone, which had become fixed transversely, in a patient treated by M. Tanchou, had led to the suspicion of disease of the bladder. Small substances, such as pins, &c. more frequently lodge beneath Houston's valve.

The vertical columns, or folds, of the rectum are intersected, or, rather, united, by transverse lines in the form of small valves, having their concavity directed upwards. If it were demonstrated, as maintained by Sabatier, Ribes, and Larrey, that the intestinal orifice of a fistula never ascends beyond one or two inches, this anatomical arrangement would furnish the explanation.

The lacunæ of the rectum are so disposed, that the inferior, looking upwards, retain substances capable of producing irritation, or perforation, whilst the superior, being directed downwards, are not exposed to the same accidents. But I still, from positive facts, continue to think, with Desault and the older surgeons, that stercoraceous fistulæ sometimes open very high up into the intestine.

Among the numerous cases advanced in favour of this modern opinion, M. Ribes has remarked, that not only does the opening not occur high up, but that it may nearly always be found at a few lines merely above the sphincter. But the evidence is not sufficiently conclusive to lead us to consider this as the general rule.

Some surgeons have remarked, that, acting according to Desault, the operation would be attended with considerable danger, inasmuch as, in dividing the rectum to four or five inches above the anus, we run the risk of wounding the peritoneum. By attentively examining the relation of the parts, it is easy to prove that these fears have but little foundation. In fact, there are from two to three inches from the anal opening to the most elevated portion of the bas-fond of the bladder, upon which the serous membrane is reflected. The peritoneum descends still less on the sides, and we know that it is entirely wanting posteriorly. Besides, the cutaneous opening of fistulæ is ordinarily on a plane much inferior to the anus. We must observe, that if the rectum be perforated above the pelvic aponeurosis, the abscess would form in the pelvis, and that by this, even when

the inflammation extends towards the exterior, we may conclude that the superior opening of the fistula is much lower than the peritoneum.

The *mucous membrane* lining the rectum, supple and elastic, is united to the muscular coat only by very loose cellular tissue. That which is designated by the name *prolapsus ani*, in some cases, really depending upon invagination of the intestine, is, more frequently, merely swelling and eversion. We may imagine, when this occurs, it may be so much constricted by the sphincter that we can only return it after cutting through the muscle, as happened to Delpech. Re-occurring at each evacuation, its relaxation terminates in such considerable dilatation of the anus that nothing can remedy it. The removal of radiating folds, directed from the anus towards Houston's valve, produced very happy results to Hey, Dupuytren, and others, by the constriction, and new adhesions which followed. The vascularity and elasticity of the submucous cellular tissue cause this membrane, when converted into a state of cancer, to acquire a great degree of thickness, so much so that, when removed, it almost appears that the other tunics of the rectum have been cut away, when, in fact, they have never been touched.

The *fleshy tunic* of the rectum is almost wholly formed of longitudinal fibres, which predominate as far as the prostate, and of annular fibres, gradually increasing in number from this point towards the skin, where they form that which I have termed *internal sphincter*. M. Rigaud considers that the former inferiorly traverse the levator ani and Santorini's muscle, inclining outwards, to be ultimately attached at the inferior opening of the pelvis, becoming a dilator of the intestine.

The hemorrhoidal and termination of the inferior mesenteric arteries ramify between the fleshy fibres of the rectum, finally lost in the mucous membrane. These branches are frequently very large, as far as the lower portion of the intestine. Being chiefly distributed to the back of this organ, they may be divided in the operation for fistula, causing alarming hemorrhage.

The hemorrhoidal *veins* are very large, in part the commencing branches of the mesenteric, and possess no valves; when inflamed, they speedily transmit the inflammation and pus to the whole abdominal venous system; whence the obscure accidents sometimes succeeding the operation for fistula, excision of hemorrhoids, and all operations in the neighbourhood of the anus. In a patient who died in this manner at the Hôpital de la Faculté, in 1825, I found numerous abscesses in the viscera, and in 1836 I saw a similar case.

It was on the relations of these veins with the portal system that the ancients founded their ideas relative to diseases of the liver. Surrounding the anus, they form a plexus, by interlacing, very frequently, between the integuments and the sphincter, and

between the muscular coat and mucous membrane, and, sometimes, produce a species of erectile tissue, which is the organic cause of hemorrhoids.

The vascular web of hemorrhoids is accompanied by so many arteries, derived either from the mesenteric, or internal pudic, that their removal is frequently followed by fatal hemorrhage, where proper precautions have not been taken.

Obliteration.—Infants are sometimes born with malformation of the rectum, simply contracted in its natural opening, as in the cases reported by Roonbuysen and Boyer. In other instances, it is obliterated in its middle, although the anus exists, or is closed by a membrane, which may be placed at various heights in the intestine. In some cases there are no traces of the anus, the skin being as firm and thick over the point usually occupied by this opening as elsewhere. It has also been found obliterated through its whole extent. I have seen it open into the urethra, close to the prostate, in the bladder, vagina, or vulva in little girls, on the back of the penis, behind the trunk, across a vertebra, in the labium, or rather external, forming artificial anus. It was this latter that gave rise to the idea of establishing an artificial anus, either in the iliac or lumbar, or even, according to Bell, at the expense of the cœcum, in the right iliac fossa; but the first of these operations, performed with success by Pillore de Rouen and by M. Maitland, had, as well as the others, the great drawback of producing stercoraceous fistula, instead of a true anus, for want of the sphincter, which nothing in the world can' replace. The least reflection will suffice to show, that the same method will not apply to all kinds of obliterations of the anus.

Such are the numerous parts entering into the composition of the perinæum in man. The variations in thickness and transverse dimensions which they present, are such, that Dupuytren, in twenty-three subjects, found them differ between the ischiatic tuberosities from two inches to three and a half, and between the neck of the bladder and skin, from one inch some lines to four inches. I have compared these measurements in forty subjects, with the same results as to thickness; but for the separation of the ischia, they were from one inch and three quarters to four.

SECTION THIRD.

SACRO-COCCYGEAL REGION.

A continuation of that of the loins, the sacral region terminates the posterior of the trunk. Triangular, like the bones, whence it derives its name, limited, superiorly, by the lumbar concavity, laterally by the eminence formed, posteriorly, by the

iliac crest, it terminates by the apex of the coccyx. Transversely concave superiorly, it is convex inferiorly. In its excavation on the median line, we meet with the sacral crest and posterior surface of the coccyx. Laterally, it terminates below by a fissure, conducting into the anal region, and which is limited by the os coccygis in the centre, and the prominence of the gluteal muscles externally.

In women, who have contracted the habit of carrying the head and pelvis thrown backwards, the total curve of the sacral region is ordinarily augmented. As this disposition necessarily coincides with a deeper cavity of the posterior wall of the pelvis, and, consequently, with proportionate contraction of the sacro and coccy-pubian diameters, it is necessary to examine it with attention, when we would ascertain whether the pelvis be well or ill formed.

The *skin*, whilst it offers most of the characteristics of that of the loins, becomes much thinner as it descends; and over the coccyx, where it preserves its dense and compact texture, it loses much of its thickness.

On the median line, the *subcutaneous tissue* is firmer, as it descends, and, finally, unites so strongly with the periosteum, or the fibrous tissue and the integuments, that the skin appears adherent to the bones. The result is, that the skin of the sacrum ulcerates and sloughs, when we are obliged to keep a patient long on his back; and tumours scarcely ever acquire any great size, infiltrations form with difficulty, abscesses are rare, but the integuments, once ulcerated, are rapidly destroyed.

Here the *aponeurosis* transforms the sacral grooves into sheaths. Blending with the supra-spinal ligament of the crest of the sacrum, with the subcutaneous layer, as well as periosteum, in the inferior portion of the region, it seems to spread laterally, to give origin to a thin fold, covering the gluteal muscles, which we shall find in the succeeding region.

Muscles.—The origin of the sacro-spinal, enclosed in the canal formed by the aponeurosis posteriorly, and the posterior surface of the sacrum in front, offers no surgical consideration. A small quantity of adipose cellular tissue separates it from the fibrous wall of its sheath, as in the lumbar region. Beneath, or rather on the sides of the coccyx, we find a small portion of the gluteus maximus. However, as the osteo-fibrous sheath is only a continuation of that of the loins, abscess, by congestion, may form here, and it may receive the pus from all the regions of the abdomen, since a cellular tract prolongs it into the fascia propria of the flank, passing above the ilio-lumbar ligament.

The sacro-iliac articulation, when inflamed, also discharges its pus here, and collections, thus manifested, require the greatest attention. A young man, who had a small abscess at this situation, died at the Hôpital St. Antoine, in 1829. Caries of the

symphysis and cavity of the sacrum was the cause, the pus having escaped from the pelvis, above the ilio-lumbar ligament. In an adult, who died at the Hôpital de la Pitié, in 1831, morbid fluid, having its origin in the dorsal region, proceeded, by the same course, to point beneath the coccyx.

The *arteries*, furnished by the posterior branches of the gluteal, ischiatic, internal pudic, middle and lateral sacral, arrive by the posterior sacral foramina, and require no very great attention in operations.

The *veins*, *lymphatics*, and *nerves*, distributed like the arteries, are still less important.

The *skeleton* encloses the sacral canal, invested by a prolongation of the spinal membranes. When the union of the laminæ presented by each false vertebra, of which the sacrum is originally formed, is, from any cause, prevented, the sacral canal is transformed into a deep gutter. If the pouch, which is then developed at the expense of the membranes and integuments, projects outwards, it is called *spina bifida*. We may conceive from this, that such a disease, having its exciting cause in the condition of the marrow, must be extremely dangerous, and lead to death, immediately air is permitted to enter.

As the sacral canal never completely closes inferiorly, except by means of the sacro-coccygeal ligament, we should be surprised that the spina bifida does not, in preference, escape at this point, did not the bony fissure become more and more narrow, the smooth surrounding tissues denser, and the natural curve of the bone more decided towards the coccyx. Once, however, I met with this case. The child was a week old, and appeared otherwise quite well; the tumour was as large as my fist, soft, fluctuating, and the investing skin red, and tolerably thick. We caused it almost entirely to disappear by compression, and then the child had convulsions. It was developed, and attached, by a large pedicle, to the posterior surface of the coccyx. We may say, in general, that the *spina bifida* only projects externally, on account of the incomplete ossification of the spinal canal, whether it points in the sacral or any other portion of the vertebral column.

In the adult, the sacral canal does not enclose the spinal marrow, since that terminates opposite the second lumbar vertebra.

The nervous branches, which go to the pelvic plexus, are alone met with here. As this receives, also, the lumbo-sacral nerve, a transverse division, or the destruction of all the branches contained in the sacrum, is not always succeeded by complete paraplegia. These nerves are completely protected by the spinous crest and sacral lamellæ, longest and most solid superiorly, by the mass of muscles, aponeurosis, and also by the posterior projections of the iliac bone, also largest superiorly.

With regard to the body of the sacrum, it has been observed bifid or pierced, so that the rectum formed a hernia posteriorly, the tumour being mistaken for spina bifida.

Finally, the small number of examples, which we possess, of the sacrum bifid anteriorly, and of the vertebræ similarly situated, have not been sufficiently detailed for any conclusion to be drawn. I shall, therefore, only note the cause of a new species of hernia, which may ensue, and which should be named *sacral hernia.*

At birth, and during several years, the sacrum is very narrow, in comparison with what it ultimately becomes. It is upon this peculiarity that depends the small transverse developement of the pelvis in children.

The coccyx may oppose obstacles during parturition, if it rises too much towards the arch of the pubes, or when soldered to the sacrum, which is the case in women of thirty-five or forty, before they become mothers. Otherwise, its mobility allows of its being pushed back by pressure on its pelvic surface. In man, its anchylosis occurs much earlier. Blows on the seat may produce fracture; although but slightly important at first sight, this fracture is frequently followed by serious consequences. The inflammation may communicate to the surrounding parts, and, as I have seen, produce immense abscesses in the perinæum, necrosis of the bone, &c. The rectum and muscles, attached to the coccyx, by their motion render consolidation difficult. The abscesses resulting from disease of this bone, or those of the sacrum, are, also, remarkable from opening, frequently, on the margin of the anus and perinæum, where they cause a sinuous ulcer, often mistaken for fistula of the intestine. I have met with several examples; one in the case of a boy nineteen years of age. Mr. Hawkins, also, mentions a similar case.

A pointed instrument, introduced obliquely outwards, or on the sides in the superior half of the region, would easily penetrate the sacro-iliac articulation. In consequence of the exact correspondence of the posterior with the anterior sacral foramina, it might traverse from behind forwards, and wound the organs contained within the pelvis, as Beclard has observed; and the pus from the pelvis burrow beneath the aponeurosis, and that of the exterior enter the pelvis. By this opening, the spinal canal, also, may be entered on either side.

A large and strong man, who died suddenly at the Hôpital de la Faculté, in 1824, with caries of the sacrum and abscess, had the cellular adipose tissue of the spinal canal infiltrated by serous and blackish pus, as far as the dorsal region; but the fibrous sheath of the marrow was untouched. In another, who died at Tours from ulcer and caries, succeeding typhus fever, the dura mater having opened had allowed pus to enter as far as the twelfth dorsal vertebra. M. Blandin, also, mentions two cases, where the ulceration had opened the arachnoid and caused

death. M. Gerdy, who appears to question the probability of these results, had, no doubt, forgotten that the dura mater descends as far as the middle of the sacrum, and that the arachnoid completely invests the interior.

SECTION FOURTH.

GLUTEAL REGION.

Comprising the union of those parts reposing on the lateral portion of the pelvis, limited, posteriorly, by the sacro-coccygeal, anteriorly by the pubic region, superiorly by the crest of the ilium, and below by the thigh, this region, rounded and very convex, presents several bony prominences, which may be felt beneath the skin.

Thicker superiorly and posteriorly than below, *the skin* is everywhere extensible, soft, and supple. Thus, tumours developed beneath may acquire a great size, without necessarily disorganizing it. It encloses large sebaceous follicles deeply seated, and, also, numerous areolæ. Thus, furuncula and anthrax, very frequently occur here, and are, at the same time, very painful.

The *subcutaneous layer* is always formed of lamellæ, and filaments interlaced with vascular and nervous branches. As it encloses adipose cellules, its thickness varies considerably, and in its turn causes great variation in the size of the buttocks. Constituting an enormous mass in some of the African women, the *Boschiman* tribe in particular, it rarely exceeds an inch in other people. Its softness, and the abundance of the element composing it, cause phlegmon and abscesses to form frequently, and with the greatest rapidity, under the integuments of the nates. As it is only a portion of the general superficial fascia, and continuous with the ischio-rectal cellular mass, as well as with that of the thigh in general, and perinæum, pus and other fluids secreted here should be *promptly* evacuated, if we would not have the matter burrow towards these points. On the tuber ischii, it is confounded with the fibrous fold, giving rise to a bursa mucosa, which does not always exist. It does the same on the external surface of the trochanter major. These subcutaneous cavities are the cause of the formation of *hematic* or *sanguineous tumours*, which I have frequently met with. Not being of a compact texture, it allows the skin to be considerably stretched in recent wounds, and union by first intention, although there may have been great loss of substance. In the removal of tumours of this region, it is not absolutely necessary to preserve much of the integuments.

The aponeurosis, properly speaking, only exists in front of the

gluteus maximus. At this point it soon splits, anteriorly, to form a sheath for the tensor vaginæ femoris muscle. Posteriorly, it also divides to envelope the gluteus maximus. Hence, this latter muscle is sustained by two layers, scarcely fibrous, whilst the greatest part of the medius is invested by a kind of sac, half fibrous, and half osseous, and abscesses formed beneath the integuments, being limited by no deep-seated solid parts, easily burrow and penetrate among the fibres of the former, whilst on the latter they are forced to point towards the skin. The three gluteal *muscles* give the part its form, constituting the fleshy mass filling the external iliac fossæ.

The *gluteus maximus*, or most superficial, being attached to the most remote portion of the iliac crest, to the border of the sacrum and coccyx, on the one hand, and to the posterior edge of the femur, beneath the trochanter major, on the other, acts, during the vertical position, by drawing the back of the pelvis downwards, thus maintaining the equilibrium by becoming an extensor of the trunk. It also extends the thigh, and directs the knee and toes outwards. The bursa mucosa, mostly situated on the femoral surface of its tendon, although deeply seated, is subject to all diseases proper to cysts of this character. I have observed in it concretions, termed cartilaginous, similar to those often met with in the wrist.

The *gluteus medius* more particularly fills the external iliac fossa. Directed obliquely outwards and backwards, it tends specially to adduct the limb, and, also, to incline the pelvis to its side. Thus, in fractures of the ilium and body of the femur, it may become the cause of displacement, and in dislocations of the femur upon the ilium, it assists in drawing the bone upwards towards the crest.

The *gluteus minimus*, being attached lower in the iliac fossa than the maximus, more firmly supports the ilio-femoral articulation, upon which it lies; but, inserted, on the other hand, at the upper border of the trochanter major, it assists the preceding. In external and superior dislocations, it immediately covers the head of the femur, and is one of the principal agents in shortening, when there is fracture of the neck of the thigh bone. Its disposition, resembling that of the temporal, gives it great power, by multiplying its points of attachment, and the number of its fibres.

The supple, lamellous, and, sometimes, adipose cellular tissue separating these muscles, is continuous with that of the pelvis by the great sciatic notch, and, also, with that of the back of the thigh. Consequently, subperitoneal inflammation may be transmitted by continuity to the haunches, and morbid secretions, accumulated in the deep cellular layer of the abdomen, easily spread among them, to form abscesses by congestion, in the same manner that they pass from this latter point without

difficulty, beneath the ischium, and even in front of the neck of the femur, to arrive at the groin. These intermuscular layers, however, are rarely the primitive seat of inflammations.

The *pyramidalis*, *internal* and *external obturators*, and the *two gemelli*, attached on the one part to the pelvis, terminate, on the other, in the digital fossa of the femur. The first emerging from the great sciatic notch, the second and third embracing the neck of the ischium, one above the ischiatic spine, the other below the cotyloid cavity, pass transversely towards the trochanter, and are rotators of the toes outwards. The two last, inserted above and below the lesser sciatic notch, receive between them, on their posterior surface, the obturator internus, with which they are blended, so that their action on the femur is nearly similar. Lastly, the *quadratus femoris*, extending from the tuber ischii to the posterior border of the trochanter, is equally a rotator outwards, and terminates the series of small muscles, applied on the posterior surface of the ilio-femoral articulation.

Arteries.—The *gluteal*, the largest and only one belonging, properly, to this region, leaves the pelvis by the superior and posterior part of the great sciatic notch, between the pyramidalis and gluteus minimus muscles, and immediately divides, forming a kind of plexus, covered by the deep surface of the gluteus maximus, and behind the medius; so that, to secure the trunk, we must search for it in the notch itself. With regard to its branches, one of the principal runs, between the great and small glutei to the anterior iliac spine, following the curved origin of the latter muscle. A second mounts in the fibres of the former, and, also, curves, to form an arch corresponding to the iliac crest. Finally, a third, commonly the largest, turns backwards, over the origins of the sacro-sciatic ligaments.

It is useless to observe that these branches furnish others of less importance, which ramify among the fleshy fibres, and that they anastomose, superiorly, with the circumflexa ilii, lumbar, and ilio-lumbar arteries, in front with the external circumflex, from the femoral, and, inferiorly and posteriorly, with the ischiatic, and some branches of the internal pudic, &c.

The depth at which the trunk of this artery is placed, in a great measure, prevents the application of a ligature in aneurisms of either of its branches. Therefore, Messrs. Stevenson and Atkinson advise the ligature of the internal iliac itself, in these instances. But when, as in the examples mentioned by Theden, the artery be accidentally wounded, we should endeavour to expose, and either tie or compress it, as done by J. Bell, where one of the largest branches had been divided.

It is exceedingly difficult, under these circumstances, to establish rules, and, therefore, the surgeon must depend upon his own knowledge; more especially as in the case cited by Mr. Owen the aneurism occupying the ischiatic artery had been mistaken

for injury of the gluteal. M. Ruyer, also, has a preparation showing the same liability to mistake.

The *ischiatic*, also arising from the internal iliac, equally leaves the pelvis through the greater sciatic foramen, but between the pyramidalis and superior gemellus muscles, much closer to the posterior sacro-sciatic ligament. It there lies, at first, on the inner side of the pudic, but soon crosses its posterior surface to become external. Descending towards the ischio-trochanteric notch, it crosses the gemelli, obturator and quadratus muscles. Covered by the gluteus maximus, it only gives off three branches of any importance in this region; one following the external surface of the gemelli and internal obturator, to anastomose with the gluteal and anterior circumflex, on the great trochanter; another winding over the tuberosity of the ischium, to terminate in the perinæum, and external genital organs; the third, a continuation of the trunk, sometimes replacing the femoral, descends to the thigh, between the gluteus maximus, biceps and adductor magnus muscles. If one of these should be of sufficient size to produce alarming hemorrhage when divided, we may easily compress the trunk, in its passage behind the lesser sacro-sciatic ligament, by proceeding according to the same method, as already indicated for the internal pudic, in the article on the perinæum. In large, fat individuals, however, we must not reckon too much upon this.

Emerging from the cavity, the *internal pudic* places itself immediately upon the anterior sacro-sciatic ligament, close to its attachment at the spine of the ischium. It there lies in the summit of a triangle, formed by the external border of the great sacro-sciatic ligament and the pyramidalis muscle, covered only by the gluteus maximus, and in such a manner that, during the relaxation of this muscle, it is possible to obliterate the vessel for a moment. We may, also, easily expose and tie it in this situation, when we cannot secure its principal branch in the perinæum, should it be wounded.

Re-entering the pelvis by the lesser sciatic notch, it remains in front of the falciform process of the great ligament, which converts this notch into a foramen. It then belongs to the perinæum, where we have already studied it. There is, consequently, no branch of any importance derived from this vessel, in its passage through the gluteal region, neither are its anastomoses, in that situation, of any consequence. The ischiatic, however, sometimes arises from it, between the two ligaments. I have recently seen a very fine example of this.

The *veins*, filled with valves, are much larger and more numerous than the arteries, since each of the latter is, in general, accompanied by two veins, which are in immediate contact and firmly attached to it.

Thus, injection thrown into the pelvic veins has difficulty in reaching them. They are scarcely of any importance in surgery.

As in all other parts of the body, the *lymphatics* are arranged in two planes. One, superficial or subcutaneous, passes to the groin; the other accompanies the blood vessels, and enters the pelvis; whence diseases of the skin and subcutaneous tissue produce swelling of the inguinal glands; whilst abscesses, inflammation, and other diseases, if deeply seated, re-act rather on the organs contained in the pelvis. It should be known, also, that we sometimes find one or more glands near the principal vessels; but they are by no means regular, whether as to number, size, or position.

The *gluteal, lesser sciatic,* and *internal pudic* nerves, distributed like the arteries, require no further comment, with relation to surgery, than that they should be avoided in tying the vessels, after amputation at the hip joint.

The *great sciatic,* accompanied by the internal pudic artery, leaves the pelvis between the pyramidalis and superior gemellus muscles. It at first lies external to the artery, but subsequently leaves it as it descends, remaining without the ischium, whilst the vessel is directed inwards; the gluteus maximus covers it to below the ischio trochanteric fossa, where it arrives, after having crossed the gemelli, obturator and quadratus muscles. Considered as the seat of disease in *neuralgia sciatica,* its size and distribution sufficiently account for the violent pains which often characterise this affection. It is so placed that compression between the great trochanter and coccyx, or ischium, may suspend its functions for the moment. Thus we quickly experience a sensation of cold, pricking, and numbness in the corresponding limb, when we sit, for any length of time, with the weight of the body resting upon one haunch.

The *skeleton* is composed of the ilium, the tuberosity of the ischium, and the sacro-sciatic ligaments.

As the first of these bones is inclined downwards, its crest causes instruments to slide over its external surface. Very thin in its centre a ball, sword, or any pointed instrument may thus penetrate into the pelvis. Being large, badly sustained, it is easily and frequently fractured, although thickly padded by muscles. The ischium is capable of fracture, notwithstanding its strength and thickness. This, however, but rarely occurs, as its position shelters it from external violence. As these two bones support the weight of the body in the sitting posture, and incline towards each other, this disposition favours transverse contraction of the perinæal opening in *mollities ossium* or *rachites.* Their inward inclination may be equal or unequal, according to the degree of pressure exercised upon them individually, or the extent of disease.

The ischium is so united to the sacrum and coccyx, by means of the *sacro-sciatic* ligaments, that one running from the sacral margin towards the sciatic spine divides into two the foramen circumscribed by the other, and that the latter extends from the

same border, or from the posterior superior spinous process of the ilium, to the internal lip of the tuberosity of the ischium. Of these two openings, the superior, oval, larger, gives passage, in the middle, to the pyramidalis muscle; the gluteal nerves and vessels, superiorly; the large and small sciatic nerves and vessels, the internal pudic artery, veins, and nerve, inferiorly. At their exit from the pelvis, all these parts are covered by a fibrous membrane, which is only an expansion of the external superior margin of the great sacro-sciatic ligament, soon terminating in the cellular tissue; and which, in a very especial manner, strengthens the posterior portion of the great sciatic notch, naturally more feeble in this situation. Nevertheless, the viscera escape through here in *ischiocele*, because the arch of the pelvic aponeurosis, completely filled, posteriorly and inferiorly, by the sacral plexus and pyramidal muscle, does not leave any other space free. No one is now ignorant of the relation of the displaced parts in ischiatic hernia, or the course which they pursue to the margin of the anus.

Having traversed the notch above or below the pyramidal muscle, they are enveloped by peritoneum, fascia propria, and the fibrous expansion just mentioned. The great sciatic nerve, and the gluteus maximus muscle and vessels, are pushed backwards and inwards. The pudic vessels and nerve remain external. The hernia slides between the gluteus maximus and the posterior surface of the great sciatic ligament, descending in the ischio-rectal excavation, between the coccyx and ischium. To the preceding investments we must add a layer, detached from the posterior sciatic ligament, to pass to the superficial surface of the gluteus maximus; a second layer, furnished by the subcutaneous tissue; lastly, common integument. We may, also, comprehend that, instead of arriving at the perinæum, this tumour may as well, and even more easily, pass directly through the ischio-trochanteric notch, and arrive at the posterior surface of the thigh; but, as Dr. John is the only one who has ever examined this disease in the dead body, and as Sir A. Cooper, who relates these facts, gives no details of the relative position of the parts, we must wait for other observations before enlarging upon the subject.

The other, or inferior opening, much smaller, is triangular, and filled by the internal obturator musle, as well as the pudic nerve and vessels, running to the internal surface of the tuberosity of the ischium, &c. We must remark, that the spine of the ischium, to which one of these ligaments is attached, sometimes protrudes inwards, into the true pelvis, contracting one of its diameters.

The articulation of the ilium with the sacrum is so effected, that, in the natural condition, all motion is prevented. The mass of yellow fibrous tissue, constituting the posterior sacro-iliac ligament, is intimately united to the bony surfaces; but, during

pregnancy, all the fibrous parts surrounding this articulation imbibe so much fluid, that its mobility becomes sufficiently manifest, in some females, at the approach of labour, to render progression difficult, even dangerous. Chaussier and Beclard have seen this separation carried sufficiently far to allow of the thumb being placed between the pubes. I have, myself, seen two examples, and I knew one woman who was in this condition at every pregnancy, after the fifth month. Ramollissement of the posterior symphyses of the pelvis assists materially, when we are obliged to divide the pubes. It would, otherwise, be impossible to separate the bones, beyond some lines, without straining or tearing the anterior sacro-iliac expansion; whilst its existence admits of nearly an inch of space in front, without danger.

We should observe that, in this case, as in all those where the inflammation and pus penetrate from the pelvis, between the articulating surfaces of the sacrum and ilium, caries and necrosis speedily follow; a peculiarity depending partly on the articulating cartilage adhering completely to the sacrum, whilst the ilium is entirely deprived of it, instead of being covered merely by a very thin layer, as described by some writers.

Not only does this articulation soften and become relaxed in pregnant women, but occasionally, also, in infants. This phenomenon then constitutes a serious disease, in which we see the corresponding limb elongate or shorten several inches, from the yielding of one of the haunches; an affection which, without being very common, is by no means rare. L'Héritier has published one curious case, and M. Guersent has informed me of two. It is almost useless to observe, that this has often been mistaken for a disease, termed spontaneous luxation of the femur.

If it be true that the strength of the sacro-iliac ligaments renders luxation of the sacrum on the ilium, or the ilium on the sacrum, difficult, we must, also, admit, that the articulation of the first, and its relations with the organs, transmitting the weight of the body, are extremely favourable to this displacement. Taken transversely behind, and near its base, it is larger towards its anterior surface, and forms an angle, tending to separate the ossa ilii from before backwards, at the same time that it forms another vertically, tending to prolong them from above downwards; consequently it falls upon the feet. It is so disposed that the vertebral column projects it forwards. It is, therefore, incorrect to say, that here their surfaces are so wedged as to offer the utmost resistance to luxation. On the contrary, we must be surprised that this does not occur more frequently. That of the ilium is, in reality, almost impossible from behind forwards; but, in the vertical direction, we possess numerous examples. The sacrum is better disposed than the ilium to resist force, directed from the centre to the circumference, whilst the ossa ilii, on the contrary, more efficaciously resist external violence.

CHAPTER TENTH.

CAVITY OF THE PELVIS.

SECTION FIRST.

SOFT PARTS.

A KIND of cul-de-sac terminating the abdomen, of which it forms the floor, about four lines deep, the cavity of the pelvis presents, superiorly, the form of a triangle, having its base anteriorly very much inclined downwards and forwards. Invested by a complicated aponeurosis, it encloses the bladder, rectum, and several other parts.

Peritoneum.—This membrane envelopes the rectum, forming, posteriorly, a fold much longer superiorly than inferiorly. Reflected laterally, to invest the excavation, it adheres but loosely to the subjacent organs. Inferiorly, over the sides of the bladder, the peritoneum forms two half circles, termed posterior vesical ligaments, circumscribing the entrance of a deep *excavation*, prolonged more or less downwards, between the bladder and rectum, which I have called *recto-vesical.* Its summit is attached to the base of the prostate, by the *prostato-peritoneal* aponeurosis of M. Denonvilliers, and the small intestine is sometimes so much implicated as to be completely constricted.

The peritoneum adheres more to the posterior and superior portion of the bladder than its sides. In fact, it presents the same characters in the pelvic excavation as in the rest of the abdomen.

The *cellular tissue*, or *fascia propria*, forms a sheath for all the vessels, nerves, and to the ureters. It interposes between the peritoneum and bladder, where it constitutes the *external nervous tunic* of the ancients. It does the same over the rectum, envelopes the lymphatic glands, is separated from the pelvic aponeurosis by large and soft fatty vesicles, and extends everywhere, in a word, between the walls of the pelvis and the organs contained within this cavity, between these organs and the serous membrane of the abdomen; merely being the pelvic portion of the general layer investing the peritoneum through its whole extent. Very loose over the sides, and in front, it favours phlegmonous inflammation, the products of which it transports with the greatest facility from one point to another.

Over the anterior surface of the sacrum, this layer becomes blended with the periosteum, and termination of the pelvic

aponeurosis. It thickens, &c. in consequence of chronic diseases of the pe itoneum, and allows pus to burrow from the lumbar and iliac regions into the pelvis. Finally, it transmits the serum effused beneath the peritoneum to the deep-seated parts of the lower extremities.

Pelvic fascia.—The aponeurosis of which we had but vague notions before the time of M. J. Cloquet, described several times since with great minuteness, especially by M. Carcassone, and still better by M. Bouvier, is fixed, superiorlly, to the circumference of the abdominal boundary of the pelvis, where it is continuous with the fascia iliaca, but separated from it by a kind of transverse fibrous ribbon, flattened on the circumference of the excavation. That of one side is separated from that of the other merely by an interval of about half an inch, behind the symphysis pubis. Posteriorly, its two halves, divided by the middle portion of the sacrum, terminate at the sacro-iliac articulation. In front its fibres descend over the neck of the bladder and prostate, to form the anterior vesical ligaments, between which we observe a small excavation, filled with fat, which gives passage to the dorsal veins of the penis. There are some more openings external to these ligaments, equally filled with fat and small veins.

Subpubic canal.—Still more externally the fascia pelvica is attached to the everted fibrous arch of the subpubic foramen. The resulting foramen, which is traversed by the obturator vessels and nerves, is only the pelvic orifice of a canal, which opens among the deep muscles of the thigh, and by which the viscera may escape, producing hernia. It is, however, too small for these displacements to occur easily, since it scarcely admits of the extremity of the little finger. From these various points of attachment, the pelvic aponeurosis descends obliquely inwards, and forms an inclined plane, looking upwards and backwards. Its fibres unite by converging to a very strong band, extended from the spine of the ischium to the posterior surface of the pubes, external to the anterior vesical ligaments. From this point, the fascia ascends over the sides of the rectum and bladder. Its first portion is applied over the levator ani muscle anteriorly, and over the internal obturator externally; so that it may there be called a process of the *obturator fascia.* The second, raised over the side of the intestine and bladder, constitutes the *recto-vesical* aponeurosis. Its strength is much less than that of the former. The band upon which these two folds unite, and which may be named *ischio-pubian,* corresponds to the superior border of the two aponeurotic layers of the anal region, forming the bottom of a fissure or excavation, deeper posteriorly than in front, representing in the pelvis the *ischio-rectal* excavation of the perinæum. It resembles a sort of central cord, on which four fibrous layers appear to abut.

A third portion of the *fascia pelvica* binds down the pyramidalis muscle, attached to the sides of the sacrum, and also the coccyx, on one hand, in front of the greater notch, and the ischiatic spine on the other. This fold superiorly forms an inversed arch, similar to that in the *subpubic canal*, converted into a foramen by the great sciatic notch of the ilium, and through which pass the nerves from the sciatic plexus, the gluteal, internal pudic, and ischiatic vessels, representing an oblique plane, facing that of the *obturator process*. On the opposite side it unites with that of the corresponding obturator, on the internal surface of the ischium, at the spot corresponding to the bottom of the ischio-pubian fossa. Between it and its fellow, there is, in front of the sacrum, a triangular space, having its base superiorly, and separated from the rectum by cellular tissue and fat, or on which reposes the meso-rectum. Below, from the ischiatic spine to the front of the coccyx, this layer is only separated from the posterior portion of the recto-vesical fold by a fissure, which, oblique from before backwards, and without inwards, re-unites the ischio-pubian and sacral fissures.

Supposing the rectum and bladder to be raised, the aponeurosis of the pelvis presents a lozenge-shaped surface, having one angle on the coccyx, a second behind the pubes, and the two others on the internal surfaces of the ischiatic spines. Its four layers, that is, the two folds of the pyramidalis, and those of the obturator, really present four triangles, having their blunt apices directed downwards; the two anterior being the largest, in consequence of the inelasticity of the portion of the sacrum upon which the posterior lie. They thus form four inclined planes, looking in opposite directions, and which are important in females during accouchement. From this arrangement, we see, that the floor of the abdomen is much less strong and resistant in the parts invested by the recto-vesical aponeurosis, than in the circumference of the pelvic cavity; and that the weakest point of all is that which separates the neck of the bladder from the rectum. It is also there that it is proposed to puncture in certain cases of ascites, and that abscesses burst either into the intestine or bladder; and that the viscera escape from the pelvis in hernia of the perinæum.

The aponeurosis of the pelvis presents other openings, for the passage of small veins or arteries, by which also enter filaments of nerves, and small fatty prolongations; but these orifices are too small to require attention. The *ischio-coccygeal* muscles and *levatores ani*, covered in the pelvis by the anterior surfaces of the pelvic aponeuroses, whilst the rectal fold of that of the perinæum invests their exterior, are almost enclosed between these two folds. Their fibres converging from the pelvic circumference to the side of the bladder and rectum, they raise the floor of the pelvis, and tend to dilate the rectum, rather than to compress the contained fæces, to cause their ejection.

The *pyramidalis* is also enclosed in a species of canal, formed by the anterior surface of the sacrum, or sacro-ischiatic ligaments, posteriorly, and the fold of the pelvic aponeurosis anteriorly. This canal appears more or less raised, according to the size of the muscle.

The *obturator internus*, filling all the obturator fossa, is also contained in a sac, constituted by the ischiatic fibrous layer of the perinæum, by the obturator process in the pelvis, and externally by the bones and thyroid membrane.

The *arteries* traversing the pelvis are numerous; many among them are very large. With the exception of the middle sacral, they are all given off by the internal iliac. This trunk separates itself from the primitive iliac, opposite the sacro-iliac symphysis, or rather, as we have seen, between the articulation and sacro-vertebral angle. Before furnishing the pelvic arteries, its length is from one and a half to two inches, and the space where we might apply a ligature is very limited; and it is a fact of great importance, that one is longer than the other. Their relations are nevertheless similar on the right and left.

The internal iliac descends on both sides as low as the ischiatic notch; on the left, it is between the middle sacral, which is within and posterior; the ilio-lumbar, which ascends to the iliac fossa; the lumbo-sacral nerve, on which it is placed posteriorly, and rather externally; the obturator nerve, which crosses its outer wall nearly at right angles; the ureter, which does the same anteriorly and internally; and the peritoneum, which covers the whole. To the right, the corresponding vein is quite external, whilst on the left it is at first behind.

The situation of the trunk of the internal iliac, and the distribution of its branches, would appear, at first sight, to render its ligature impossible, on the one hand, and, on the other, prevent this operation from ever becoming necessary. This however, is not the case. Being enveloped in the elastic tissue of the fascia propria, it is easily isolated from the ureter, ilio-lumbar artery, sacro-lumbalis nerve, and even from the internal iliac vein. The obturator nerve, forming a kind of cord, which may be felt and distinguished, from its direction, is the guide in placing the ligature between it and the origin of the gluteal artery. We should apply the ligature as closely as possible to this branch, if we would avoid the bifurcation of the common iliac.

Opposite the great sciatic foramen, the hypogastric artery spreads out, if we may so express ourselves, and its *gluteal* branch at first, subsequently the *internal pudic*, and, finally, the *ischiatic*, all given off above the aponeurotic arch, converting the notch into a foramen, pass between the branches of the sacral plexus of nerves, and thus emerge from the pelvis. The *vesicular* and *middle hemorrhoidal*, which arise from its anterior,

remain behind the peritoneum, and descend tortuously in the fascia propria, as far as the posterior surface of the rectum.

The *obturator* is directed forwards, following the contour of the abdominal opening of the pelvis, to the subpubic foramen. Placed against the bone, and penetrating the subpubic canal externally, in thyroid hernia, the vessels are to the outer side of the neck of the tumour.

The *ilio-lumbar* and *lateral sacral* are of no further interest, than that they may arise higher than usual, and from the hypogastric; in which case they would more or less interfere with the application of the ligature on this trunk.

The *veins* are much larger than the arteries, which they equally surpass in number. They are distributed in the same manner, and have valves, preventing their being injected by their common trunk. Their walls are very thin, so that without great caution we may very easily wound them in attempting to tie the artery, and thus give rise to alarming hemorrhage.

Stretched, either by the fibrous arches, or by their relations with the aponeuroses, arteries, peritoneum, or viscera, the veins of the pelvis, like most of those of the perinæum and circumference of the anus, gape when divided. This disposition renders wounds extremely serious, and suffices to explain the frequency and dangers of phlebitis after labour, amputation of the uterine neck, or uterus itself, lithotomy, and all operations performed in the pelvis.

The *lymphatics* are very abundant. The glands surrounding nearly all the principal arteries are observed, particularly behind the rectum, and near the ischiatic notch, around the trunk of the hypogastric artery. We very frequently find some attached to the obturator nerve, previous to its entrance in the subpubic canal. Finally, they form a very complicated plexus with vessels of the same order, swelling and inflaming in most of the deep-seated diseases of the limbs and perinæum.

There are two classes of *nerves;* one, very delicate, appertaining to the *great sympathetic,* form the *hypogastric plexus.* Distributed, principally, to the bladder and rectum, these two organs are not entirely under the control of the will. The other, *spinal,* supply the obturator, sacro-lumbalis, and sacral plexus, which, placed on the anterior surface of the pyramidalis muscle, runs above the fibrous arch of the ischiatic notch to the haunch. Thus, a tumour, or any other cause of compression, acting on the posterior inclined plane of the pelvis, may give rise to paralysis, or, at least, numbness of the back of the thigh and leg. The superior ischiatic notch is, therefore, completely filled by the sacral plexus of nerves, and the three principal branches of the internal iliac artery. Nevertheless, the observations related by Papen, Verdier, and Camper prove, that the

intestines may protrude, and form a large hernia, at the margin of the anus, which is not always easily distinguished from perinæal hernia; with which it appears to have been more or less confounded.

Bladder.—Having already examined the neck of the bladder in the perinæal region, we have now only to observe its body and summit, or superior portion.

The peritoneum is very firmly united to it posteriorly. In front it lies against the pubes, so that it may easily be wounded in *symphyseotomy*, and project externally in separation or congenital absence of these bones. As it is not covered by the peritoneum in this situation, it is possible to extract stones here, when they are too large to be removed through the perinæum. If the bladder were always to surpass the superior border of the pelvis, the high operation for lithotomy might, perhaps, be the least dangerous of any; but this is not the case. When empty, it is commonly below this point. It is, therefore, only when in a state of distension that it really prolongs the serous membrane above the symphysis, and, unhappily, not always so far. In old men, and in very many persons suffering from stone, the bladder is contracted, and, as it were, buried in the pelvis. Its walls, also, are so much thickened, and the organ has so long lost the habit of dilating, that it becomes impossible to distend it. Its softness allows it to yield under pressure. The abundant cellular tissue, uniting it to the pubes, and the subpubic aponeurotic triangle, and which, according to the dissections of M. Thomson, separates it from the recti muscles above the symphysis, admits in its turn of the bladder being so easily displaced that it has more than once been pushed back by the fingers or instruments, so as to produce a large pouch between it and the front of the pelvis; which, through ignorance, or to hide their faults, surgeons have frequently described as a proof of a double bladder. Two facts, published in the Journal of Medicine in 1828 and 1829, belong, I think, to this class. From its position, we may, after the incision of the external parts, stretch it with the left index finger bent, so as to draw up the peritoneum, which fixes it to the linea alba. This method, proposed by M. Baudens, prevents all displacement, and supersedes all injections and instruments for distending the bladder.

The thickness of the linea alba, of the recti or pyramidal muscles, the supra-pubic aponeurosis, and cellulo-adipose tissue, above the symphysis, induced M. Duvon to select the space between the border of the rectus femoris, the body of the pubes, and the course of the epigastric artery, for his incision in the high operation; but the peritoneum, the vessels more easily wounded, and the smallness of the opening which could be made in the bladder, militate against such a proposition.

The tendency of the urine to flow through the hypogastrium,

after the high operation, may be explained as follows. In the horizontal position, the wound occupies a point almost as depending as the most elevated portion of the urethra, supported in front by the suspensory ligament of the penis. Pressed by the action of the abdominal viscera as much as by the contraction of the bladder, and arrested by the resistance of the prostate, the fluid escapes more easily through the artificial opening than through the urethra. It has never been remarked, that the bladder in the high operation, being cut from above downwards as far as its neck, and even to the prostate itself, the inferior angle of the wound, when the patient is lying down, in reality corresponds to the perinœal border of the symphysis, whilst the commencement of the spongy portion of the urethra is constantly elevated nearly half an inch above and in front. This peculiarity in itself alone accounts for nearly all the dangers attending the high operation, and for the inutility of sutures, &c., as preventives of infiltration. Laterally, the bladder presents nothing remarkable.

It is placed a little to the left, according to Celsus; but this writer expresses himself too laconically for us to understand whether he would speak of the base or summit of the organ. If it be certain that the bladder, very frequently, is directed from above downwards, and slightly to the left, for which reason this side is selected for the lateral perinæal operation, it is equally so, that the body and bas-fond alone experience this inclination, being pushed by the rectum. The urachus and urethra, forming the two extremities of the organ, being on the median line, also show that its axis must correspond to that of the body.

Among infants, the bladder, more elongated, approaches nearer to the umbilicus. Being thus much less buried in the pelvis, the supra-pubic operation presents greater chance of success with them than among adults. More evidently continuous with the urachus, and curving less to pass beneath the arch of the pubes, it has scarcely any bas-fond. For several years enjoying considerable extensibility, and placed, as it were, without the pelvis, it projects into the hypogastrium when distended.

In ischuria, I have observed that, at all ages, it thus retires from the pelvis, leaving a void in the rectum, instead of compressing that organ, as is generally supposed.

Its mucous membrane, remarkable for its thickness, and from the small quantity of follicles contained in it, secretes mucus in large quantities, in ancient catarrh, becomes fungous and covered with inequalities in persons who have been afflicted with calculi for any length of time, and forms transverse folds, against which the point of the sound or catheter striking may lead to the belief of the presence of stone.

Its muscular coat consists of fibres disposed in several directions. Some, annular, collect so intimately, superiorly, that Par-

sons has described them as a particular muscle, under the name of *detrusor urinæ;* others are oblique. Most of them form curves, and follow the axis of the organ. We not unfrequently find them assembled in columns or parallel fasciculi, between which the peritoneal and villous tunics are in immediate contact. These fasciculi are sometimes intersected in different directions by other fleshy bands, depending on the approximation of the circular or oblique fibres. In these bladders, calculi very easily form culs-de-sac, in which they become imprisoned, taking the name of encysted calculi. MM. Bussiere, Berard, Repault, and I have met with cases where some of the cysts were, beyond measure, distended, the bladder appearing double, triple, and even four times its natural size.

The cavity of the bladder being lower at its fundus than the commencement of the urethra, we must elevate the handle of the sound, inclining it to the right, left, &c. when we would ascertain the presence of a stone. As the bladder is always more or less inclined downwards and backwards, the bistouri caché does not so often injure the walls as might be expected. Its posterior wall, thin, free in the peritoneum, corresponding to the recto-vesical excavation, is easily perforated in catheterism, so that some surgeons have had the courage to choose this cavity for puncture in ascites.

Effusion into the abdomen leading to the belief of retention of urine, explains how the bladder may be traversed, whilst we consider that we are merely sounding the patient. This accident occurred, to my knowledge, at one of the large hospitals of Paris, in 1825 or 1826. They sounded the patient, and no urine came away; they pushed with greater force, and a very large quantity of serous fluid escaped.

Here was ascites, and the instrument had penetrated the peritoneum. I was sent for three times, in 1832, to urgent cases, and I then saw how very easy it would have been to have made the mistake, if we were not previously aware of the possibility of these facts. One of the patients had not passed his urine for four days, and had his hypogastrium very much distended; I found the bladder empty. He died the same day. An intestinal rupture, from external violence, had caused effusion.

Finally, the bladder, dilating only at the expense of its thickness, becomes extremely thin, when it mounts into the hypogastrium. Thus, it would be very easy to rupture it by any violence, or rather by pressing upon the abdomen. In this condition the pelvis, no longer protecting it against external agents, an effort during labour, a kick, blow, &c., would rupture it without difficulty. We thus see how necessary it is for the prognosis, after blows on the abdomen, to inquire the condition in which the bladder was at the moment of the accident. But we also see, that when the rupture occurs in front, the

fluid, escaping to the exterior of the peritoneum, leaves some chance of cure, whilst, posteriorly and superiorly, fatal peritonitis is, almost necessarily, the result. On the coutrary, when it flattens, or contracts on calculi, the walls may acquire several inches of thickness. It is remarkable, that large calculi, more particularly, cause this contraction and thickening; whence it follows that the high operation, so far from being applicable for these latter, as some surgeons consider, is in fact much less so than any other.

The rectum, the continuation of the sigmoid flexure of the colon, extends from the left side of the sacro-vertebral angle to the anus. Its direction is such that it presents two marked curves, one moulded on the anterior surface of the sacrum, the other formed by the intestine descending, at first, obliquely, from left to right, as far as the median line, sometimes passing it, and again inclining to the left. Very mobile superiorly, it is sometimes much nearer the cœcum; whence, without doubt, the assertion of some modern anatomists, who maintain, contrary to what has always been considered, that the rectum is as often, on the right as on the left, and sometimes oftener. I have examined it in a great many subjects, and have but rarely met with this transposition. Most frequently, I have seen it in front of the left sacro-iliac symphisis, and only arriving at the middle of the sacrum at its inferior portion.

The rectum becomes more fixed as it descends, because the mesenteric fold, sustaining it posteriorly, entirely disappears below. In those cases where it is habitually dilated, the walls thin so much, that the viscera, pushed into the recto-vesical excavation may separate the fibres, producing herniæ in its cavity, instead of sliding between the prostate and its anterior surface, towards the perinæum.

Internally, it is the same as in the perinæal region. Its mucous membrane, wrinkled as in this latter point, encloses numerous follicles. Frequently diseased in phthisis, and in most adynamic and ataxic fevers, may not these favour the formation of the fistulæ and stercoraceous inflammations, which sometimes succeed these affections?

The *muscular coat* of the intestine is very strong and thick. All its fibres being longitudinal, the rectum is, as it were, contracted at this part of its course. It is so easily separated from the mucous membrane, and so thick, that the latter is generally divided, for some considerable distance, from it, in fistulæ or abscesses at the margin of the anus. Thus, we may, ordinarily, introduce a probe between them to the extent of three, four, or even five inches, although the perforation exists close to the sphincter. From the same cause, abscesses, forming between them, burst, in preference, into the intestine, producing internal blind fistula. The arrest of stercoraceous matter in the pelvic dilatation of the rectum, explains, in its turn, the odour and colour

of the fæces, observed in deep abscess of the perinæum, although there is no communication with the intestine.

We also find, in the pelvis, a portion of the *ureters* and *deferential canals* so disposed, that the former descend, crossing the iliac vessels beneath the peritoneum, and follow the external side of the recto-vesical excavation, to reach the sides of the bas-fond of the bladder, and that the latter pass, obliquely downwards, from the inguinal canal to the prostate, crossing the ureters and external iliac vessels, behind the origin of the epigastric arteries. These four cords, enclosed in the external portion of the ring, which limits the recto-vesical excavation above, may evidently be compressed by the intestines. In some cases, where they are enormously dilated, we can trace the cause to no other source. We have already seen, whilst studying the arteries, what precautions these organs require, when we apply a ligature upon the latter.

The *cellular tissue*, or *fascia propria*, of the pelvis, extremely loose, and very thick, continuous with that of the hypogastrium, iliac fossæ, and loins, &c. explains, in the first place, how pus, formed here, may burrow, in spite of its own gravity, towards these various regions, and, in the second, how a disease, commencing in the kidney, ureter, or meso-colon, arrives so easily in the pelvis; producing so much thickening of all the sub-peritoneal soft parts, that the bladder and rectum become, as it were, strangled: as I saw at the Hôpital de la Pitié, in 1831, in the body of a patient whose ureter and ascending colon had been perforated by a pin. Its continuity with that of the thigh, by the obturator canal and the great sciatic notch, also show, how abscesses of the inferior extremity, especially of the hip joint, may enter the pelvis, or those of the latter extend to the limb. Finally, how suppuration of the circumference of the rectum or bladder, caries of the sacrum, internal surface of the cotyloid cavity, or symphyses, may, after having ruptured the pelvic fascia, ascend in front of the bladder, towards the inguinal canal, and burst above Poupart's ligament, in the same way that the cellular tissue of the meso-rectum explains the formation of fistulæ in ano, succeeding disease of the sacrum, the front of the vertebræ, whether lumbar, dorsal, or cervical. There is not one of these accidents which I have not witnessed, and I have no doubt that they frequently occur.

Skeleton.—In consequence of the relation of the pubes with the bladder and urethra, fractures of these bones often wound the genito-urinary organs. In a subject of from twelve to fifteen years of age, who died at the Hôpital St. Antoine, in 1829, the fractured pubes had completely ruptured the urethra. In another case, the bladder was perforated. The fractured ischium, in a subject I examined in 1825, had torn the corresponding vesiculæ seminales.

An osseous growth, the crest projecting behind the symphy-

sis, as is frequently observed, too great convexity of the sacro-vertebral angle, exostoses in some one point of the pelvis, being likely to project into the bladder, have more than once been mistaken for calculi. All these anomalies beneath the upper opening, would be a great, and, sometimes, complete obstacle to the extraction of calculi by the perinæum. The contraction of the pubic arch, the approximation of the ischia, a constriction, from whatever cause, of the inferior opening, would produce the same inconvenience. It was thus that Noel was obliged to employ the high operation, after having, in vain, attempted the extraction by the perinæum, in a subject whose pelvis and calculus were shown me by M. Lozes.

CHAPTER ELEVENTH.

OF THE FEMALE PELVIS.

SECTION FIRST.

PERINÆAL REGION.

In addition to the same parts as in man, the female perinæum encloses all the external organs of generation, with the exception of the seminal glands.

The following are the average dimensions of several subjects: from the top of the pubes to the clitoris, two inches and a half; from the anterior commissure of the vulva to the anus, three inches and a half; from the clitoris to the posterior commissure of the vulvular opening of the vagina, one inch and a half; from the posterior commissure of the vulva to the apex of the coccyx, three inches; from the coccyx to the anus, about eighteen lines; from the anus to the vulva, fifteen lines. Its transverse dimensions offer nothing of interest, excepting on the skeleton. We will first describe the soft parts.

The *skin* is rather less mobile and delicate than in man, and is covered by fewer hairs, especially posteriorly. In folding, to form the labia majora, it looses its cutaneous characters, and assumes those of mucous membranes. There are no hairs on the internal surface of these folds, and the sebaceous secretion, more abundant, is of a different nature. Very frequently, it becomes acrid, irritates the parts, and may produce, in dirty, careless people, a discharge which has more than once been mistaken for blennorrhagia.

The labia majora, firm and round before puberty, more or

less flabby, soft, and elongated in married women, leave a fossa between them and the thighs, at the bottom of which we may feel the pudic artery. Continuous, superiorly, with the mons and superficial fascia of the abdomen, the external surface of their root corresponds to the ring of the external oblique muscle. Thus, inguinal herniæ nearly always extend here, when of any size, and gangrene, or perforation of the intestine, produces inflammation of the parts. Between the superior portion of their internal surface and the nymphæ, we find a triangular space, uniting with a similar one of the opposite side, above the clitoris.

The *labia minora* are merely folds of integument, much longer, in proportion, in very young girls than after puberty. In the latter, they may, accidentally, become so elongated as materially to prevent copulation, and require an operation for their removal. According to Perron and Lesueur, it is this lengthening of the nymphæ, observed among some of the native women of the Cape of Good Hope, which constitutes what is called *Hottentots' apron*, (tablier des Hottentotes.) It is true that Le Vaillant is not of the same opinion; that the jesuit Jackard describes this apron as a simple fold of skin; and that Salzman has denied its existence, advancing that the fictitious apron, habitually worn by these females, had deceived travellers. However, the Hottentot female, described by Cuvier and Virey, and drawn by M. Flourens, presented this singular prolongation of the labia minora, which are so long among Asiatic and African women, that they are frequently obliged to have a portion removed to allow of copulation.

The *skin* of the perinæum, properly so called, resembles that in man, and equally possesses the raphé on the median line.

The *subcutaneous tissue* becomes very thick at the great and lesser lips. Its melange with the vessels, nervous filaments, and fat, produces an elastic, firm web, like erectile tissue, frequently the seat of phlegmonous inflammations, accompanied by intense pain, which proceed rapidly towards suppuration, and, consequently, require very energetic treatment, either by applying several leeches at the commencement, or by opening, *early*, when pus has formed; otherwise the mischief will extend rapidly and considerably.

Arrested, externally, by the attachment of the superficial fascia to the ramus of the pubes and ischium, and, internally, by the perinæal aponeurosis, the suppuration, restrained by the consistency of this layer, near the skin, then spreads, in preference, towards the perinæum, or anus, producing ulcerations, liable to be mistaken for intestinal fistulæ; the more so as true stercoraceous abscesses often point on the internal surface of the valve. The elasticity of the tissues, internally, demonstrates how collections of all kinds, whether in the circumference of the

rectum, or neighbourhood of the urethra, tend, when left to themselves, to open here, and how ulcers, succeeding abscess, are so far from the seat of disease.

The cellular tissue being more supple, and thinner at the adherent than free border of the labia majora, their abscesses should be *largely* opened, to prevent reproduction and other evil consequences. The numerous veins which they enclose, being also very deep-seated, produce, when ruptured, collections in the vulva, which become large, but deep-seated. Should we have occasion to practise incision in these cases, it should be both *largely* and *deeply*.

The aponeurosis presents a large opening, circumscribing the vagina. Its two laminæ are indistinct in front. Supporting the perinæum, it is sometimes sufficiently strong to resist for a long period; preventing dilatation of the vulva during accouchement, and the introduction of the hand into the rectum, or vagina, especially among females who are confined for the first time.

The *muscles* are the same as in the other sex, with respect to the coccygeus, erector clitoridis, and levator ani; but the sphincter ani and constrictor vaginæ (*bulbo-caverneux*) are rather different. The first of these, in fact, is so disposed, that the anterior extremities of its two lateral halves evidently interlace in many persons, and are uninterruptedly continuous with the transversus perinæi muscle, which then seems merely a dependence of it. This disposition, which I have many times met with, is very well represented in one of Tiedemann's plates on the arteries. The second forms a new sphincter, moulded upon the bulb, which it embraces, so that its two portions are enclosed in the two great lips. When these contract, their curvature almost disappears, and then the bulbous opening of the vagina is more or less diminished. In some women, who have the power of contracting it at will, this muscle acquires very large size.

The *arteries* are smaller, in proportion, than in the other sex.

The *inferior*, or *external hemorrhoidal*, is situated nearly as in man; the same is the case with the *transversus perinæi*, which is much smaller. The superficial artery, distributed in the labium majus, is so inconsiderable, that little hemorrhage follows its division.

The trunk of the pudic itself is so small, that it merits no attention, where it approaches the summit of the arch of the pubes. Thus, in the various perinæal operations for lithotomy, dangerous hemorrhage would not occur, unless the principal trunk, which is too far from the median line to be injured, were divided.

The *veins*, *lymphatics*, and *nerves* are disposed like the arteries.

The *urethra*, in women, is remarkable for its shortness, extensibility, and structure. Its length varies from ten, fourteen, to twenty-two lines. It is conical, and susceptible of consider-

able dilatation. Large calculi may traverse it, and thus escape from the bladder. Heister, Midleton, Collot, Sir A. Cooper, and others, have reported cases, where stones of two, three, and four ounces, and Daniel Angelus from nine to twenty-five even, have been expelled simply by its organic action. Hence, Tolet, Blomfield, and others proposed its artificial dilatation, rather than incision, in the extraction of foreign substances.

Enveloped by thin erectile tissue, and not by a prostate*, simply prolonged from the bladder, it is slightly concave on its anterior surface, easily traversed by a straight sound. During pregnancy, it is so much raised against the posterior of the symphysis pubis, that it becomes, as it were, perpendicular, and then a strongly curved catheter is necessary to attain the bladder. It is sometimes so flattened under these circumstances, that in England the round has long been superseded by the flattened instrument. Its interior presents no urethral crest, prostatic excavation, nor valvular fold. Superiorly, it is separated from the pubic arch by an interval of four or five lines, and is the same distance from the inferior surface of the clitoris; between which and the meatus urinarius, there exists a triangular fossette, limited, laterally, by the labium minus. Thus, lodged at the summit of the pubic arch, the urethra, in women, is less exposed than we should imagine to pressure from the head of the fœtus during labour.

The mucous membrane, dense cellular tissue enclosing vessels, and a prolongation of the constrictor muscle of the vagina; the superior portion of the perinæal aponeurosis, in the midst of which we find the termination of the internal pudic artery; supple elastic cellular tissue, and nearer the urethra a layer of erectile tissue; finally, the anterior portion of the neck of the bladder, are the parts which would be divided in the operation for lithotomy, if, as has been erroneously proposed, we penetrated between the urethra and symphysis. In dividing the whole length of the urethra, at its superior wall, as performed by Collot and Dubois, with a simple bistouri introduced upon a conductor, or with the bistouri caché of Frère Cosme, we may obtain an opening of an inch or fifteen lines. But when the calculi are very large, the high operation is less dangerous.

The neck of the bladder and the urethra are only separated from the vagina by a thin layer of dense, compact, cellular tissue; we can, therefore, penetrate the bladder, with great facility, through the vulvo-uterine canal. If the recto-vesical operation be successful in men, lithotomy by the vagina should be still more so in women, as here there are neither vesiculæ seminales,

* M. Velpeau is incorrect in stating that the female possesses no prostate. There are two preparations in the museum of the school, made by Mr. Owen, belonging to Mr. Guthrie, and described by him, at pages 35 and 36 of his work on the diseases of the urethra, &c. in which these organs are well shown.—H. H.

deferential canals, nor ejaculatory ducts, and the venous plexus is much less.

I agree with M. Phillipe, of Rheims, that it is possible to extract a calculus of nine ounces by this space, without producing abortion in pregnant women.

The relations of the bas-fond of the bladder, the urethra, and the vagina are such, that, in the attempts to divide the neck of the bladder obliquely downwards and outwards, either as performed in men by Frère Jacques, or by introducing the bistouri caché by the urethra, as recommended by Frère Cosme, and as many surgeons have since operated, it is very difficult to avoid the organ of copulation. In married women of a certain age, particularly those who have borne children, the front of the vagina is, as it were, grooved for the reception of the urethra. In incising the latter, therefore, even if transversely, we are not certain of always avoiding the former. Nevertheless, we must remember, that before puberty the vagina is so small, that this would not be the case, if, on the other hand, simple or double division of the urethra were not to be dreaded from the incontinence of urine, which sometimes succeeds it.

The *meatus urinarius*, much smaller than the rest of the canal, is separated from the anterior opening of the vagina, by a more or less inflated tubercle, which requires much attention when we pass the catheter, without exposing the woman. It is, in fact, easily felt by passing the tip of the middle finger upwards from the inferior commissure to the vestibule, so that when recognized, if we hold the instrument like a pen, and direct it over the extremity of the finger, it will slide into the bladder without any difficulty. I must add that this tubercle, which terminates the anterior column of the vagina, sometimes swells in recently delivered women, so much as to close the meatus, and presents one or more lacunæ upon its projecting surface, resembling the entrance of the urethra.

The *vagina* is an organ having no analogy in the perinæum of man. Its anterior orifice, is, generally, bounded by four tubercles, in women who have had children. These tubercles, ordinarily placed on the extremities of the vertical and transverse diameters, are called *carunculæ myrtiformes*. The anterior and posterior are only the termination of the corresponding columns of the vaginal cavity. The two lateral depend upon the retraction of the flaps of the hymen. These should be well understood, to prevent their being mistaken for syphilitic productions.

At birth, and up to puberty, unless destroyed by accident, the opening is contracted posteriorly by a semilunar fold, having its concave margin directed forwards, and called the *hymen* or *vaginal valve*, tearing at the first connexion with man, and frequently, even before puberty, from violent exercise; but which

at other times, is so large and strong, that it nearly closes the vagina, interfering with, if not entirely preventing, the flow of the menses. It has been found sufficiently strong to oppose copulation, but to allow of fecundation proceeding until the period of accouchement, interfering so much with the birth of the child, as to require division.

These circumstances sufficiently indicate that the presence of this membrane is not a sufficient proof of the innocence of a female, in the same manner that its absence speaks nothing against her morals. The hymen, commonly festooned like a ruffle, especially when it represents a ring instead of a half moon, sometimes encloses muscular fibres, and even cavernous tissue. At others it has the appearance of a mere horny lamella; but it never encloses large vessels.

The interior of the vagina is remarkable from the numerous wrinkles there met with. These, the nature of which has not hitherto been sufficiently examined, are of two orders; one parallel to the direction of the canal, the others passing obliquely over them.

The former, only two in number, one *anterior*, the other *posterior*, very apparent towards the exterior, gradually disappearing as they approach the neck of the uterus, frequently swell during pregnancy, and, also, when the uterus is empty, sufficiently to embarrass persons who are ignorant of this peculiarity. We may, also, imagine that they are capable of projecting, each representing a kind of crest, and even touching each other, or uniting by their free borders, producing a complete septum.

The second, supple and soft during pregnancy, much denser, and giving to the touch, when examined in women who are not enceinte, a sensation similar to that experienced from passing the finger over the palate of a ruminating animal, have fissures between them, at the bottom of which syphilitic ulceration frequently lies concealed. Thus, it requires a very attentive examination to discover the disease in this sex.

From the relations of the vagina to the bladder, when the pelvis is narrow, the head of the child during labour may bruise the common septum, giving rise to a sloughing, succeeded by fistula. For the same reason, the bladder easily projects across the vagina, and the descent of the uterus is nearly always complicated with vaginal cystocele, either as the cause or effect. The relation between the vagina and rectum is, also, very important. From it results the *recto-vaginal septum*, on the concavity of which the head of the infant presses very strongly, when it traverses a pelvis in which the sacrum is too much curved, and which often tears during travail. The accouchement then terminates by the anus, or it may cause a slough, the separation of which produces recto-vaginal fistula. The intestine, curving backwards to the anterior surface of the coccyx, presents a slight convexity anteriorly. As the vagina, on the contrary, descends

regularly in the direction of the axis of the inferior pelvic opening, these two organs, thus separating from each other, leave between them a triangle limited by the posterior surface of the vagina in front, by the anterior surface of the rectum behind, and below by the skin extending from the anus to the vulva. Filled with fat, cellular tissue, some fibres of the transverse and sphincter muscles, the constrictor vaginæ, and levator ani, by some branches of the transverse artery, a portion of the erectile tissue, which surrounds the vagina inferiorly, this triangle becomes considerably elongated, when the head of the fœtus is about to pass through the inferior opening. All its layers, flattening, yield, then distend, and the perinæum of the female is soon three or four inches long, so that the infant may tear and traverse it with rupturing the commissure posterior to the vulva, or the anterior portion of the anus.

I was called, in the spring of 1824, to Madame B——'s, who had been twelve hours in labour; I found the midwife sustaining the perinæum with all her strength. The cranium of the fœtus had already escaped through the perinæum, the anterior border of which was uninjured. I thought that the head was in the anus, but soon after the birth of the infant I was easily convinced of the contrary. Science is now in possession of several similar facts, which I have collected.

The parts enveloping the vagina, laterally, are the same as those in relation with the rectum and bladder in man. Between the posterior portion of its opening and the perinæal commissure of the vulva, are the fossa navicularis and fourchette, which disappear, or are torn by dilatation during labour; but these accidents are of no importance, unless they implicate a portion of the perinæum, properly so called.

When the perinæal aponeurosis, as well as the other layers entering into the composition of this region, offer less resistance than ordinary, or are relaxed from any cause, the vagina may be everted like the finger of a glove, and the neck of the uterus itself appear at the vulva. This constitutes *prolapsus uteri*, which may then be compared to *prolapsus ani*, and M. Deiffenbach has successfully applied the same treatment; that is, excision of a portion of the surrounding integuments. Heming, Tanchou, Berard, and I prefer removing a large fold of skin and mucous membrane, and reuniting the wound by suture. M. Laugier expected to obtain the same results by the use of caustics. M. Fricke contents himself with contracting the posterior portion of the vulva. The credit, however, of these various methods belongs to M. R. Gerardin, who first communicated them to the Academy of Medicine. The aim in all cases is to contract the vagina and its boundaries; therefore, either of these operations is likely to succeed.

It may happen that the *os tincæ* is prolonged enormously, as observed by Lallement and Bichat. In the case of Margaret

Malame, reported by Saviard, it resembled a penis. When the uterus descends, it is necessary, if we would apply a flat pessary, to recollect that it may be sufficiently large to rest upon the ischia, and when once placed, would be retained in position by the floor of the perinæum; especially by the aponeurosis, which is only an enlargement of the falciform process of the great sacro-sciatic ligament; whilst from before backwards the bladder and rectum will not allow of its being so large. We ought to be upon our guard against the causes of error, when we examine these descents, as certain polypi so closely resemble the form of the neck of the uterus, that we may mistake, and endeavour to reduce them, as I once did.

SECTION SECOND.

PELVIC CAVITY.

The *entrance* of the cavity here requires some attention. The following are the results of its examination on several subjects: its form is triangular, the apex reaching the origin of the primitive iliac vessels, and presents the sacro-vertebral angle, upon which the middle sacral artery lies. The base of this triangle having for its skeleton all that portion of the pelvis comprised between the ilio-pectineal eminences, presents, firstly, in the middle, the summit of the bladder; secondly, laterally, the two pubio-vesical fossettes, bounded by the umbilical ligament; thirdly, a little more externally, the internal crural fossettes, limited by the external iliac and epigastric vessels. Its sides, formed by the psoas muscles and iliac vessels, have, posteriorly, the ureters and internal iliac vessels. In man, the deferential canal slides in its antero-lateral angle. Hence, in the natural condition, the superior pelvic opening in the female is much larger anteriorly, or obliquely from before backwards, than in any other direction. The space between the iliac vessels, at the point where they reach the superior surface of the horizontal portion of the pubes, is four inches and a half. From the same point, that is, the external portion of the crural ring to the sacro-iliac notch of the opposite side, it is, also, four inches and a half. Whilst from before backwards, it is but four, and transversely, in the centre between the psoas muscles, but three and a half.

This opening is a plane strongly inclined forwards and downwards, in consequence of the sacrum being much more elevated than the pubes; and when the psoas muscles are tense, it is evident that the space is greatest in the latter direction. There is, consequently, nothing surprising in the occiput tending to reach one of the lateral angles of the space, though it at first presented in a different direction.

The sacro-iliac notches, being almost completely filled by the

psoas and other soft parts, cause the position in which the infant presents the occiput, directly forwards or backwards, to be far from impossible, as we should be tempted to consider from merely examining the skeleton. Two inches lower, that is to say, beneath the psoæ, the cavity no longer presents the triangular figure of the proper opening; we then find five inches transversely, and only four from the symphysis pubis to the sacro-lumbar angle. But in prolonging a line horizontally backwards, allowing for the inclination of the pelvis, this diameter is five inches; and the head, once arrived in the middle of the true pelvis, would proceed equally well in one direction as the other, if the tortion of the trunk did not prevent it.

The rectum, rather less inclined than in man, in consequence of the great size of the pelvic cavity, thus explains the preponderating frequency of perinæal herniæ on the right over the left side. Its dilatation is, also, more considerable from the habitual constipation amongst the greater number of females.

The recto-vesical excavation here becomes *recto-uterine*, or *recto-vaginal*, and descends lower than in the other sex. The ligaments forming the circumference evidently enclose, in many subjects, a fasciculus of muscular fibre, or of the same nature as those of the uterus. This cul-de-sac being very deep, the intestine may be constricted during pregnancy; meeting with less resistance than superiorly, they swell freely, whilst the uterus compresses them above. We can understand how the viscera, implicated here, project into the vulvo-uterine canal, forming vaginal herniæ.

The *recto-vaginal excavation* has not hitherto been sufficiently studied. The fœtal sac may be placed here in extra-uterine fecundation, and project into the vagina. De Caigneau called me in, in 1829, to a female who presented a remarkable example of this, confirmed by post-mortem examination. It is in such cases, in particular, that rupture may occur in the rectum or vagina, and that it would be easy to extract the fœtus by incising the posterior wall of the latter canal. The fundus of the uterus being reversed is, also, the cause of various and numerous accidents. In a lady who died after fourteen years of suffering in the whole of the abdomen, and constipation, there was no other lesion. In another, whom I saw with M. Deligny, there was an enormous abscess closed by adhesion superiorly, and which it would have been impossible to have emptied by the vagina. Long maintained in this state, the parts rarely fail to contract some inflammatory lesion, some degeneracy, rendering reduction for ever impossible, and which, although mere bands, are perpetual causes of sterility and abortion. We should penetrate here, in vaginal paracentesis, for ascites, and this point, from its weakness, is most likely to yield in labour, and is frequently perforated in excision of the neck of the uterus.

The union of the rectum with the vagina, denser in the median line than laterally, in its turn explains why hernia is more frequent on the side than in the centre. Should the intestine slide more externally, hernia of the labium majus might occur, differing so little from that named perinæal, that Scarpa appears to confound them.

The parts implicated by the vagina frequently unravel the wall of this canal, and are only covered by the mucous membrane, cellulo-fibrous tissue, and the peritoneum, forming the hernial sac. No large vessels are here met with, and if constriction occurs, we do not see what need prevent its removal. Should they penetrate the lips of the *pudendum*, or project into the perinæum, the recto-vesical aponeurosis and levator ani muscle would tear or be considerably weakened. They are then enveloped by skin, sub-cutaneous tissue, the fibres of the transversus perinæi, and constrictor vaginæ muscles, by another cellular or aponeurotic layer, by the levator ani muscle, and pelvic aponeurosis if it be not torn, by the fascia propria, and, lastly, by peritoneum. In the latter cases, the neck of the sac is so far from the exterior, and the branches of the internal pudic so large, that the operation would be attended with danger.

The greater number of perinæal herniæ, in women, arise from the larger size of the pelvic cavity; whence Scarpa appears to consider that, when these tumours are met with in man, there must be some characters in the pelvis proper to females.

The *uterus*, united to the broad ligaments, divides the pelvis into two portions. Maintained only by membranous folds, it may move, and follow the direction to which its weight inclines it. The greater convexity of its posterior wall would draw it more backwards, and incline it to that side; and uterine *retroversion* and *retroflexion* are much more frequent than permanent *anteversion*. Its retroversion once commenced, the packet of intestines press on its anterior surface, instead of sliding posteriorly, forcing it more and more downwards; and its fundus, pressing on the rectum, renders defecation proportionably difficult. The bladder is, moreover, so intimately attached to it, that it pushes it towards the sacrum, or tends to elevate it towards the pubes, according as it is full or empty.

As the peritoneum only covers the uterus as far as the neck, anteriorly, it is almost impossible to wound it in vaginal lithotomy; and the cul-de-sac, separating it from the bladder, is thus much more shallow than that in front of the rectum.

The os tincæ, although embraced by the superior extremity of the vagina, nevertheless, projects sufficiently into this canal to be seized and excised. We must not, in such circumstances, forget that the peritoneum and bladder are very close, and that an incision of some lines from the centre to the circumference would easily wound them, especially backwards.

The vagina, the broad ligaments, the bladder, and the floor of the pelvis, are sufficiently loose and supple for the uterus to be expelled by muscular action, and then to acquire so large a size as to prevent its return.

Not only does the mobility of the uterus allow the displacements already described, but it also admits of the entire organ, with the Fallopian canals and ovaries, escaping above the pubes. Chaupart has met with these parts in a sac, which traversed the inguinal canal, in the body of a woman aged fifty. Lallement made a similar observation in a woman of the same age, and another in one of eighty-two.

At first sight, there is nothing in the anatomical arrangement to account for the possibility of such herniæ. During pregnancy, we may, on the contrary, imagine that this organ may escape through the walls of the abdomen, or the inguinal ring, or crural canal, which appears to be the ease, according to the observations of Sennert, &c.

The broad ligaments enclose, in their superior border, the ovary and its ligament, the Fallopian tube, and round ligament.

The *round ligament*, a mere fasciculus of the proper fibres of the uterus, enveloped by peritoneum, extends, forming a half circle, with its convexity directed outwards, towards the inguinal canal, to spread out in the mons Veneris, groin, and greater lip. Stronger and shorter on the right than left, it is thus the cause of the frequent inclination of the uterus towards that side.

These ligaments tend, by their contractility, to raise the uterus towards the pubes, and not to lower the neck towards the penis, during copulation, as considered by some writers. During pregnancy, on the contrary, they evidently support it, drawing it downwards and forwards. I have twice seen the round ligament of the right side so manifestly contracted, as to form a tense cord, very distinct, whilst the uterus acted to expel the placenta.

The *ovary*, mobile, like the Fallopian tube and uterus, drawn by the latter organ in all its displacements, may proceed alone towards one of the natural openings in the abdominal parietes. Vayret, Pott, Lassus, Denux have met with it in the inguinal canal.

The observation of Pott is particularly curious, proving that the ovary may be extirpated without much danger.

The female then, by degrees, looses the characters of her sex. This gland is formed of a proper tissue, and enveloped in a sort of fibrous shell, in which are enclosed the ova or germs, and other vesicles. If we are at a loss to understand how so resistant a membrane breaks, and permits an ovum to pass into the tube, we may easily conceive that, its central hydatids dilating, the ovary becomes transformed into a large pouch, either single or

multiplied, according as one or several vesicles are diseased at the same time.

The ovarian cysts may thus fill the whole of the abdomen, mount to the diaphragm, and completely resemble ascites, pushing the intestines towards the side of the spine; which I have often seen, particularly in a woman, aged thirty-two, who died at the Hôpital de la Faculté, in 1824. A stimulating injection would not produce such a catalogue of frightful symptoms as have been supposed to follow such introductions into the peritoneum, as the ovarian pouch then forms an isolated sac, having no essential connexion with any other organ of the abdomen. Neither, if the tumour had not contracted adhesions by its surface, would its extirpation be so exceedingly dangerous. We may also imagine that a cyst, or any other tumour, plunging into the pelvis, may contract such relations with the vagina, that it might be possible, in cases of necessity, to empty or extirpate it by this canal.

With regard to the Fallopian tube it is necessary to remark, that the extreme narrowness of its canal explains how a fecundated ovum may be arrested in its course towards the uterus, and give rise to tubular pregnancy; how, if altogether obliterated, the product of conception may force a passage across the fibres of the uterus, be developed in the substance of its walls, and constitute interstitial pregnancy. The thinness of the walls of this canal, on the other hand, predisposes them to rupture, whence tubular pregnancy would be converted into abdominal, and effusion take place in the peritoneum. Its free extremity being open in the form of a funnel, and connected to the ovary by one of its processes, explains how an ovum, arrested at its exit from the gland, becomes developed, creating a pouch for itself; so that it is difficult, at first, to tell whether the pregnancy is ovarian, tubular, or peritoneal.

The *broad ligament*, a mere fold of peritoneum, being continuous, laterally, with the pelvic cellular tissue, diseases of the uterus cause suppurations to spread towards the side of the abdomen, in the iliac fossa, flank, groin, &c. Various alterations, such as phlebitis, induration, and adhesions, observed either in the pelvis, or the rest of the abdomen, arise from the same source.

The bladder, rather more elevated above the pubes than in man, allows of hypogastric lithotomy being performed with greater facility, and less danger; a fortunate circumstance, as we are frequently obliged to have recourse to it in this sex. Pressed by the uterus, during pregnancy, its neck is raised behind the symphysis. Becoming nearly vertical, or so flattened that excretion of the urine cannot take place, the bladder enlarges. At the period of labour, it may thus neutralize muscular contraction, or break under its influence, if we did not take the

precaution to empty it, at the commencement of the pains. Compressed between the pubes and uterus, it ultimately becomes larger than in man, and sometimes is, as it were, divided by a gutter moulded on the front of the uterus.

The relations of the bladder with the uterus allow of hernia in the vagina. It may equally slide to the sides to descend into the labium majus. It approaches the inguinal and crural openings in pregnant women, and sometimes in others, sufficiently to be liable to protrude, should any force be applied from behind. De la Porte observed double inguinal cystocele in a woman of seventy; Pott in a girl of six, and another of thirteen. Leveret and Virder have found the bladder in the groin, passing through the crural canal. Leveret mentions a case where the bladder simultaneously caused hernia in the vagina and crural arch.

With the exception of the dimensions, all else in the pelvis of the female resembles that in man. The peritoneum, fascia propria, aponeurosis, muscles, vessels, nerves, and arteries, are almost analogous. Instead of deferential canals, there are uterine and vaginal veins and arteries.

The ovaries replace the vesiculæ seminales. Almost all these vessels, at first enclosed in the broad ligaments, must necessarily be divided in complete extirpation of the uterus. The situation of the iliac veins and arteries, on the sides of the opening, causes them to be compressed by the uterus, after three or four months of pregnancy, preventing the return of venous blood, and producing the varicose state so frequently remarked in the hypogastrium and lower extremities of pregnant women. Lying on the spine, the aorta itself may be compressed during travail, explaining the cerebral congestions and bloated condition of the face. The obturator nerve, placed at the entrance of the cavity, encounters the strongest compression, at the moment when the head passes through the opening, and accounts for the cramps or pains then experienced in the groin and upper part of the thighs. Separated from the opening by the tendon of the psoas, the crural nerve, on the contrary, scarcely suffers any thing from the developement of the uterus. The sciatic plexus, occupying the inferior region of the pelvis, remains free until the head arrives in the perinæal opening, and shows why the cramps of the whole length of the limb are only felt towards the termination of accouchement.

The *uterus* also merits long details with regard to gestation; but these would exceed our limits. Let us merely remark that, if it does not ascend opposite the pubes until about the third month, it surpasses the upper opening by nearly two inches during the fourth; that, towards the end of the fifth month, its fundus approaches very closely to the umbilicus, which it passes during the sixth; that it does not reach the epigastrium until the end of the seventh but nearly fills that region in the eighth:

and, lastly, that, during the ninth, it descends, rather than mounts. During this ascension, the uterus inclining to the right by turning on its axis, the cæsarian operation, performed on the median line, would fall near its left border, become anterior, and, consequently, on a part abundantly supplied with very large vessels.

CHAPTER TWELFTH.

OF THE EXTREMITIES.

IRREGULAR cones, the limbs are the essential organs of motion. Generally villous, their skin requires to be carefully shaved when they are wounded.

The transverse or semilunar lines, observed in the neighbourhood of the articulations, serve as guides in operations. Fissures, grooves, and depressions are also frequently met with. Being parallel to the muscles, vessels, and nerves, the latter are a great guide in ligature of the arteries, and indicate the direction for incisions, which may be required in diseases of the part; there are, also, bony, fleshy, and fibrous eminences. The subcutaneous tissue presents the same characters as cellular tissue in general; consequently they are very subject to phlegmonous and diffused inflammations. The superficial veins, for the most part voluminous, very apparent at the exterior, are nearly the only ones opened in phlebotomy in the present day. The aponeuroses of the limbs are the most complete and complicated of the body. The septa or laminæ, detached from their internal surfaces, form as many secondary sheaths as there are fleshy fasciculi. Their great mobility accounts for their luxations. The reason of the fractures of which they are so frequently the seat, is found in their exposure to external agents, and in the disposition of their skeleton. Lastly, the multiplied uses to which they are destined, and their texture, even, are sufficient reasons for the numberless diseases to which they are subject, and the variety of operations performed upon them.

Developed by a kind of vegetation, and commencing about the fifteenth day of conception, they are susceptible of numerous malconformations; some by anomaly of developement, others by destruction, disease, &c. I saw, in company with M. Gasnaule, a fœtus, enormous in other respects, in which the four extremities were not above a few inches in length, although they contained the bones in their natural order. A little woman, aged thirty, whom I saw in 1825, was in the same condition. I once

met with a fœtus in which the arms and thighs were wanting, although the fore arm and legs were well formed. The American journals have given the history and drawing of a young person, aged twenty, entirely deprived of limbs, but otherwise properly formed. The various modifications of club-foot and deformities of birth are well known.

SECTION FIRST.

THORACIC EXTREMITIES.

Appended, as it were, to the chest, and free along the trunk, the superior or thoracic extremities of man, pushed outwards by the clavicle, resemble no other part in this assemblage of characters. Their coniform or cylindrical shape, the support furnished by their muscles and aponeuroses to the subcutaneous tissue, allow of compression being applied with better effect here than elsewhere, and cause the dissipation of diffused inflammation in an admirable manner. More numerous, shorter, and communicating more frequently with the deep-seated, their superficial veins have scarcely any valves. Free up to their entrance in the axilla, having no fibrous arches nor rings to pierce, as in the thigh, the circulation through them is rarely interrupted, and, consequently, they are seldom varicose. The acromion, external condyle, and thumb, which mark the external border of the upper extremity, the head of the humerus, internal condyle, and little finger distinguishing its internal border in supination, become, the one anterior, and the other posterior, in pronation, and should be borne in mind in fractures.

Thoracico-humeral region.—The arm, in addition to the shoulder, gives rise to a second region, the axilla, by uniting to the chest.

Subclavian or *axillary region.*—The *axilla*, the most important region of the upper extremity, limited, superiorly, by the supraclavicular region, inferiorly by the free border of the great pectoral and latissimus dorsi muscles, externally by the humerus and scapulo-humeral articulation, and, internally, by the chest, thus represents a pyramidal excavation, free at its base, and continuous, by its apex, with the neck.

A large superficial groove, depresses its anterior wall, and merits the name of *subclavian excavation* or *depression.* More marked in thin individuals, its depth is increased, when the arm is approached to the trunk. Superiorly, there is a triangular space, by which the joint may easily be penetrated. Limited, externally, by the head of the humerus, internally by the coracoid process, and superiorly by the clavicle and acromion, this triangle is the

point selected for the entrance of the knife, in amputation at the joint, according to the method of M. Grosbois.

Below, the subclavian excavation terminates in the *anterior border of the axilla*, a kind of rounded arch, the concavity of which looks downwards, of considerable thickness in fat, but very thin, and almost sharp, in lean subjects.

At its base, the axilla presents an excavation, the *cavity of the axilla*, the depth of which augments in the depression of the arm. Its form is triangular, having its base on the chest. A rounded border, like the preceding, and enclosing the anterior surface of the teres major and latissimus dorsi muscles, or the *posterior border of the axilla*, circumscribes it posteriorly. By placing the finger in the cavity of the axilla, we may feel through the skin, when the individual is not very fat, lymphatic glands, head of the humerus, brachial plexus of nerves, and the pulsation of the axillary artery.

Skin.—Delicate, and very elastic in front, still finer below, very extensible, and of a deeper colour there than elsewhere, covered with hair, which is never very long, but more abundant in man than woman, and not developed until puberty, the skin here encloses follicles, which secrete the unctuous matter always found in the axilla. This matter, in greater or less quantity, as we know, according to individuals, sometimes gives off a very strong odour, principally among persons whose hair is white or red, and at others is sufficiently acrid to produce excoriation of the part.

The subcutaneous tissue is composed of a variety of objects; first, of fat and cellular tissue, subsequently of blood vessels and nerves. Its adipose vesicles, more abundant in front than at the bottom of the region, may form an extremely thick layer. Thus, in stout individuals, the cellular tissue of the axilla appears slight, whilst it represents a distinct and strong lamella in those who are thin. The cutaneous surface of the lamella, unequal and filamentous, supports the adipose cellules. The other, lamellous, smooth, does not adhere very firmly to the aponeurosis. It is in this layer that the cephalic vein ramifies. The cellular tissue of the cavity of the axilla blends with the aponeurosis, and encloses several lymphatic glands in its areola.

Aponeurosis.—Beneath the greater pectoral and latissimus dorsi, the *brachial fascia* is disposed in the following manner: one of its laminæ, mounting in front, as a simple cellular membrane, attaches itself to the clavicle, penetrates the coraco-clavicular triangle, thus gains the contour of the articulation, and adheres strongly to the muscular fibres. At the side of the shoulder, this membrane may always be distinguished from the subcutaneous tissue. We should carefully avoid mistaking abscesses, which form external to it, for those developed beneath. The former invariably tend towards the skin, and are not more

dangerous than those in the limbs. The latter, on the contrary, always extend towards the axilla. Another layer slides behind the greater pectoral and invests its posterior surface. The same disposition takes place for the latissimus dorsi; the posterior portion, however, being rather stronger. The process passing in front of this muscle, also strong, is thinner as it ascends, so that it soon becomes nothing more than a lamella, running to the posterior surface of the pectoral muscles, having invested the free surface of the sub-scapular and serratus magnus. The proper cellular tissue, appearing to result from a splitting of these aponeuroses, as they pass from one border of the axilla to the other, forms an assemblage of layers and filaments continuing uninterruptedly to the axillary aponeurosis, with which it contracts most intimate union. Prolonged, in addition, into the supra-clavicular region, it is thus a means of communication between the axilla and the posterior region of the neck, through the space existing between the trapezius, levator anguli scapulæ, and scaleni muscles. Thus, we find the reason why the axilla is the common rendezvous for all surrounding suppurations.

By destroying the cellular tissue, gangrenous inflammations give rise to great mischief; in the first place, by leaving a space, which is, with difficulty, effaced otherwise than by methodical pressure on the subclavian depression; secondly, by being frequently succeeded, when the cure is effected, by contraction of the whole cavity, which may for ever destroy the functions of the limb; thirdly, by allowing the introduction and exit of a certain quantity of air, leading to the belief of communication with the lung, as I saw in a remarkable example, during 1832. This phenomenon, which, as described by M. Blandin, is sometimes the result of rather deep wounds, and may cause emphysema, does not depend upon the motions of the arm, as that author supposes, but rather on the alternate dilatation or contraction of the chest; fourthly, by, for a long period, interfering with the course of the lymph or blood, and the nervous functions throughout the whole limb, leaving it predisposed to œdema, erysipelas, abscess, &c.

Muscles.—The *pectoralis major* is separated from the skin by the aponeurosis, superficial fascia, some vessels and nerves. Its fibres converge from the clavicle and ribs to the humerus, so that to reach the axilla, it is quite sufficient to isolate its fasciculi, without dividing it. Inserted into the anterior lip of the bicipital groove, the pectoralis major prevents the long tendon of the biceps from slipping out in front. A more or less distinct fissure, which we may call *coraco-deltoid fissure*, larger superiorly than inferiorly, and filled with adipose cellular tissue*,

* In addition to this adipose cellular tissue, we find the cephalic vein and a division of the thoracico-acromialis artery in this fissure.—H. H.

separates it from the deltoid. The coracoid process commonly lies to its upper portion, but more deeply seated.

The pectoralis minor, extending from the coracoid process to the external surface of the third, fourth, and fifth ribs, crosses the posterior surface of the preceding, nearly at right angles, and is separated from it by thick cellulo-adipose tissue, containing vessels of some magnitude. Its posterior surface passes over the axillary vessels and nerves, in such a manner, that we may reach these organs, above and below, without dividing it.

Its superior border forms the base of a triangle, which we may name *clavi-pectoral*, the other limits of which are represented by the clavicle, on the one part, and the thorax, on the other. We here find, from the chest towards the arm, loose cellular tissue, axillary, anterior thoracic, and cephalic veins, axillary and acromial arteries, brachial plexus of nerves, and its anterior thoracic branches.

Beneath the muscle, the pectoralis major hides another triangle, larger than the preceding; the inferior side, which does not, properly speaking, exist, would be formed by the anterior border of the axilla, and would extend from the humerus to the sixth rib, being consequently about five inches in extent. Its external border, formed by the humerus, is three inches and a half, and its upper side, represented by the lesser pectoral, only three inches. I shall call this the *sub-pectoral triangle*. We here see a great quantity of cellular tissue, and from within outwards lymphatic glands, basilic and axillary veins, the artery enveloped by the nerves, a portion of the coraco-brachialis muscle, tendon of the latissimus dorsi, and teres major muscles; finally, a portion of the biceps.

I have twice seen the tendon of the lesser pectoral cross the back of the coracoid process, to be attached to the summit of the glenoid cavity. In another case, it was inserted beneath the acromio-clavicular vault; its superior border was sensibly elevated, invaded the clavi-pectoral triangle, becoming an obstacle to the ligature of the axillary artery.

The *subclavian* advances more or less into the axilla, according as the clavicle is depressed or elevated, and is covered by a fibrous lamella, to which it is attached, and to which it sometimes gives origin.

Axillary aponeurosis.—This lamella, attached to the clavicle and coracoid process, is continuous with that separating the deltoid from the capsule of the joint, and by it, with the superficial fascia of the shoulder. Splitting, to invest the two surfaces of the lesser pectoral muscle, and the common tendon of the coraco-brachialis and biceps, it descends in front of the axillary vein, with which it appears continuous superiorly. Thus prolonged over the brachial plexus, before losing itself in the cellular tissue of the axilla, very strong in some individuals, especially in front of the vein, continuous with those of the neck

and the superior opening of the thorax, it is one of the lamellæ which presents most opposition when we would expose the axillary artery. Since I attempted to point out the importance of this in 1825, M. Blandin has described the aponeurosis, under the name of fascia clavicularis, and M. Gerdy, the inferior portion, by that of *suspensory ligament of the axilla;* but it ought rather to be called *clavi-axillary*, or *coraco-clavicular*, as I at first termed it, or, still better, *axillary*, if we speak of the whole. It is this which sometimes resists intermuscular abscess of the region, frequently forcing them to the front of the articulation, in the sheath of the deltoid.

The *coraco-brachialis*, and the short head of the biceps, united at their origin from the coracoid process, soon separate, the biceps passing forwards, while the coraco-brachialis remains behind.

The *subscapularis*, the anterior surface of the teres major, and anterior margin of the latissimus dorsi, form the posterior wall of the cavity of the axilla. Between the teres major and the subscapular there is a hole, nearly quadrilateral, circumscribed by the anterior border of the subscapular above, by the teres major below, by the long portion of the triceps behind, and by the neck of the humerus in front, filled by cellular tissue. This hole, which I shall call *subscapulo-humeral*, allows axillary abscesses to spread to the posterior surface of the arm or shoulder. The posterior circumflex artery and nerve, also, pass by it.

The *serratus magnus*, fixing the shoulder to the chest, and, as it were, uniting the spinal border of the scapula to the posterior surface of the great pectoral, conceals the intercostals, and forms the internal wall of the axillary cavity.

Remarks.—It is thus easily seen that all these muscles surround a pyramidal cavity, the apex of which, filled hy cellular tissue, is continuous with the supra-clavicular region. Its anterior wall, comprising the *clavi-pectoral* and *sub-pectoral triangles*, is formed especially by the clavi-axillary aponeurosis. The subscapular, teres major, and latissimus dorsi form its posterior wall, whilst the serratus magnus almost completely bounds its internal. The internal and posterior walls of the axilla unite at an acute angle on the posterior border of the scapula. As this angle is quite closed, pus cannot extend directly from the cavity of the axilla into the dorsal region, without perforating the serratus magnus; but it easily arrives by making a slight detour. Following the cellular track, separating the superior border of this muscle from the levator anguli scapulæ, it may spread between the trapezius and rhomboid, or burrow in front of the rhomboid, to descend between the side of the chest and the serratus magnus. Arrested and turned back by the aponeurosis, it finds another course through which to reach this latter interval, by gaining the space separating the inferior angle of the scapula

from the thorax, which limits the serratus magnus in front, the rhomboid behind, the latissimus dorsi and aponeurosis below. Arrived there, the pus may penetrate as above, between the side of the chest and the two large muscles attached to the posterior border of the shoulder. The angle resulting from the union of the anterior and internal walls, still more acute, is prolonged in front of the thorax, and opposes but feeble resistance to pus spreading in this direction. The external, truncated superiorly, encloses a portion of the coraco-brachialis muscle, the humerus, and the internal portion of the scapulo-humeral articulation. This anatomical disposition permits of the axillary artery being compressed, and of abscesses of the articulation spreading into the axilla.

Arteries.—The *axillary*, the principal trunk of the region, preserves its name, from the clavicle as far as the posterior border of the axilla. Oblique from above downwards, and from within outwards, it gradually diminishes in size as it descends. Superiorly, it is nearest the thorax, whilst, inferiorly, it is closer to the arm. Thus wounds in the cavity of the axilla are less dangerous the nearer they are to the chest, whilst, superiorly, we avoid it more surely by approaching the limb. Internally are the vein and lymphatic glands; externally, the nerves; anteriorly, nerves and veins; posteriorly, some nervous branches, and a large quantity of cellular tissue. To submit these relations to practical deductions, we will divide the artery into three portions.

Clavi-pectoral triangle, in the *first portion*, extending from the clavicle to the posterior border of the lesser pectoral, the vein being internal and anterior, ordinarily covers the artery so much that during life we are obliged to push it aside in operation for aneurism. Behind the vein, this artery lies on the first intercostal muscle, the second rib, and in the first portion of the serratus magnus, but only by means of cellular tissue. Externally, it is accompanied by the inferior branch of the brachial plexus of nerves, which gradually proceeds to the front. All the other nerves remain behind, and to its external portion. Still more externally, we see the cellular tissue of the summit of the axilla; subsequently the roof, formed by the coracoid process. The subclavian muscle, in crossing, descends, for about half an inch in front of it, beneath the clavicle. A little lower it is ordinarily crossed, very obliquely, by an anterior thoracic nerve, which runs between the pectoral muscle. In front, are some dense cellular lamellæ, and the *axillary aponeurosis*. After this fibrous membrane comes a layer of cellulo-adipose tissue, the pectoralis major, the subcutaneous aponeurosis, and tissue. Dividing the *clavi-pectoral triangle* into two nearly equal portions, its direction follows that of the coraco-deltoid fissure. Thus, cutting in this fissure, we fall directly on the artery.

Beneath the pectoralis minor, the second portion of the axillary artery is covered by the pectoralis minor. The nerves, which were all placed externally, anteriorly, and posteriorly, send two cords, one anterior, the other posterior, which cross it very obliquely to produce the median at its internal side. The nervous plexus thus forms a complete sheath, and the vein does not lie immediately upon it. At present, nearer to the arm than to the chest, it corresponds, anteriorly and externally, to the biceps and pectoral, posteriorly, to the subscapular, and, remotely, to the serratus magnus within. We should never attempt to apply a ligature in this portion, as the relations already described sufficiently indicate the dangers attending such an operation. If we would compress it, the pressure should be made against the head of the humerus; but this is only easy in thin persons. We may also, as observed by Camper, apply pressure in front, across the great pectoral muscle, upon the second rib. This latter process, however, is difficult and uncertain.

Sub-pectoral triangle.—Lastly, the *third portion* of the axillary artery is met with in the sub-pectoral triangle, where it has, on its radial side, a root of the median, and the musculo-cutaneous nerve; to its ulnar side, the posterior root of the median, the internal cutaneous and ulnar nerves; externally and posteriorly, the radial and circumflex. The vein is in the same relation as in the preceding portion. Covered by the pectoralis major, it lies, posteriorly, on the tendon of the subscapular or latissimus dorsi, and on the humerus, where it may easily be compressed. In the third of its length, the axillary may be tied in two different manners. At first, by cutting parallel to its direction, in the interval between the two borders of the cavity of the axilla, as performed by M. Monoir, or by dividing the pectoralis major perpendicularly to its direction, as recommended by Desault and Delpech. In both these cases, we must expect to meet with a very strong sheath, enclosing the artery, vein, and nerve.

The *acromial*, in some subjects, separates from the trunk of the axillary, very near the subclavian muscle; but as it is more frequently close to the pectoralis minor, it is better, as a general rule, to apply the ligature higher, than lower, in front of the clavicle. It sometimes furnishes the anterior thoracic branches, at the same moment; in this case, it is at first much more voluminous. Its acromial portion runs directly in front of the lesser pectoral muscle, to bifurcate behind the cephalic vein, under the apex of the coracoid process. One of its branches passes over the dorsal surface of the bony prominence, and is lost in the deltoid muscle. This branch, which is as large as a crowquill, is naturally divided in amputation at the shoulder joint. The other branch, entering the coraco-deltoid fissure, remains at first internal to the cephalic vein, next passes

beneath this vessel to its external side, and finally runs forwards. We should not forget this circumstance, when we would perform phlebotomy here.

The *anterior thoracic* arise, the superior, in the clavi-pectoral triangle, and sometimes even from the acromial; the inferior, from the middle portion of the axillary beneath the lesser pectoral. Their branches are principally distributed to the pectoral muscles. Ramifying freely in the cellular tissue separating them, they cause great trouble in the ligature of the axillary artery.

The *external mammary*, arising opposite the inferior border of the lesser pectoral, descends on the side of the thorax, between the pectoralis major and serratus magnus, to supply the integuments. This is the most frequently opened in the removal of tumours from the cavity of the axilla. It gives off some other branches, which are lost in the latissimus dorsi and teres major.

The *common* or *sub-scapular* is found opposite the anterior border of the muscle of the same name, and descends behind the nerves, in front of the side of the scapula, where it soon bifurcates. Being the largest branch of the axillary, we should tie this latter above or very far beneath it. Its anterior branch, smaller than the posterior, is the continuation of the primitive trunk, and ramifies in the muscles of the back part of this region. The posterior or circumflex curves towards the posterior region of the shoulder, where we shall meet with it, as well as the preceding.

The *circumflex arteries* are frequently given off by one trunk, close to the sub-scapular, from which they are sometimes derived. In all cases, the posterior circumflex passes immediately behind the shoulder, through the sub-scapulo-humeral foramen. The anterior, smaller than the other, is placed behind the musculo-cutaneous nerve, the coraco-brachialis, biceps, and deltoid muscles. Applied on the bone, it divides at the bicipital groove; with the posterior it forms an arterial circle around the neck of the humerus, which may be torn in fractures of the part; whence results the large ecchymosis, frequently attending this accident.

The origin, size, number, and distribution of all these branches are capable of great variations, as is also the trunk of the axillary. I have seen it divide into two branches, one, posterior, largest, giving off the proper brachial artery, the other, anterior, smaller, formed by the radial, prolonged as far as the axilla, the division continued beneath the subclavian muscle.

Veins.—Capable, like the arteries, of being divided into three portions, the *axillary vein* is very large, and placed, at first internal, on the border of the first rib, first intercostal muscle, second rib, and serratus magnus; externally and posteriorly, on the axillary artery, to which it adheres, by means of dense

cellular tissue. Anteriorly, it receives the lamella from the coraco-clavicular aponeurosis, which fortifies its external tunic. It is next crossed by the anterior thoracic nerve and arteries; and subsequently covered by the sub-muscular, cellulo-adipose tissue, &c. When swollen after expiration, it completely hides the artery; thus Lizar's method may be of service, which was, to suspend the venous circulation below the axilla, by pressure on the limb during the operation for aneurism.

Behind the lesser pectoral, the axillary vein, crossed by the branches of the inferior thoracic artery, lies less immediately on the internal surface of the artery, being separated from it by the two roots of the median nerve; its inferior portion, still internal, is also placed in front; the median, cutaneous, and ulnar nerves interpose between them. Anteriorly, it is crossed by the external mammary artery, branches of the second and third intercostal nerves, and some other filaments. All the brachial plexus is consequently placed behind, and externally.

The *axillary vein* ordinarily receives the basilic, (sometimes its equal in size,) the collateral veins of the subscapular, circumflex, and, in some persons, internal mammary, in the *sub-pectoral triangle.* The latter vein and the basilic enter it at its internal and anterior portion, whilst the others penetrate at its external or posterior surface. Their trunks are seen in the interval between the nerves, and all constitute at this point a very complicated plexus, producing considerable embarrassment when we would expose the artery. In some subjects they remain separated as far as the lesser pectoral muscle; but this is a rare occurrence; the external mammary and inferior thoracic habitually open into one or the other of them beneath this muscle.

Although the *cephalic vein* appertains to the shoulder, its importance in surgery requires that we should here examine it at some length. It is nearly the only superficial branch meriting any attention. Lodged in the deltoid fissure, it is more or less deeply seated. When this fissure is not well marked, the vein is very superficial. When, on the contrary, the fissure is distinct as far as the bone, it is deeply seated. Enveloped in cellulo-adipose tissue, in penetrating beneath the clavicle, it passes, internal to the coracoid process, in front of the origins of the biceps, coraco-brachialis, and lesser pectoral muscles; obliquely crosses the brachial plexus of nerves and axillary artery, to enter into the vein on its external and anterior side, close to the subclavian muscle. In this course, it also crosses the acromial artery, in such a manner that this latter forms a half circle round the vein, in passing behind it. M. Huguier informed me, that he once saw it enter the axilla beneath the great pectoral muscle, instead of the deltoid fissure.

The number of veins found in the axilla render operations dangerous from two causes; first, by phlebitis, easily produced

by their injury, and, in the next place, because several of them, being maintained in their situation by solid lamellæ, appear to allow the air to penetrate, and to proceed rapidly to the heart.

The *lymphatics* are very numerous in this region. All those from the upper extremity, as well as those from the exterior of the chest, and a part from the posterior region of the neck, enter here. We find a considerable number of glands, some forming a kind of chain around the vessels, whilst the others are arranged in two series. There are some which constitute a layer, placed between the anterior wall of the axilla and the vascular and nervous plexus; and others, again, reposing between this plexus and the posterior wall of the cavity. They, also, more particularly, occupy the space separating the vessels and nerves from the serratus magnus. This circumstance is exceedingly advantageous. In fact, should their extirpation become necessary, we shall not easily be deterred by the depth at which they may be placed, when we recollect this anatomical arrangement; especially as there is a simple method of ascertaining whether we can prudently attempt their removal. This consists in separating the arm from the trunk. If the tumours remain attached to the thorax, not following the motions of the limb, it is certain that they are not intimately connected with the arteries and nerves.

We know with what facility these glands inflame and swell in the diseases of the breast in women, of the whole of the chest in both sexes, and especially in those of the upper extremity. They, thus, frequently suffice to disclose the existence of disease, where it was not apprehended. The glands of the axilla swell with great rapidity, in suppurations and virulent inflammation. In these cases, also, the suppuration sometimes invades the surrounding loose and abundant cellular tissue with frightful rapidity. Hence the vast abscesses extending into the neighbouring regions, through the medium of the cellular tissue. In swelling, they frequently produce infiltration of the limb. Their tumefaction, arrested by the thorax, extends in general by the side of the plexus: thus the tumours resulting have several times given the idea of aneurisms, where they did not exist. Although they may then be prolonged upwards beneath the clavicle, separate the pectoral muscles in front, and the deltoid externally, push the latissimus dorsi backwards, and send prolongations through all the cellular spaces already described, they may commonly be extirpated, in consequence of their point of origin, which allows the nerves and vessels to remain on their external surface. Receiving an artery and vein at their superior and external side, it is in this situation that we must tie their pedicles, when we would remove them. The axillary vein, being nearer than the artery, is more ex-

posed to injury in these operations; whilst the situation of this vein on a more anterior plane requires that pressure should be made from behind forwards.

In consequence of their relations with the vessels and nerves, we scarcely run any risk, in dissecting the diseased masses from the axilla. If we proceed from the thorax towards the arm, from below upwards, and from behind forwards, we scarcely run any risk, and their anterior surfaces may be detached with the fingers, or the handle of a scalpel, from beneath the clavicle. I thus removed, one in 1828, as large as a child's head, without any hemorrhage. In three individuals who died, the one in 1824, the two others in 1825, the vessels were so much implicated in the tumour that it would have been impossible to have avoided them; but the disease, which had acquired vast extent, did not appear to have commenced in the lymphatic glands.

Nerves.—The brachial plexus furnishes nearly the whole. In the clavi-pectoral triangle its cords are united in a fasciculus, placed behind and external to the artery. Free beneath the clavicle, and towards the summit of the axilla, it corresponds in front to the coraco-deltoid fissure, and is, consequently, separated from the skin merely by fat, cellular tissue, and the transverse branch of the acromial artery, the cephalic vein being more internal. These relations do not prevent its being very deeply seated, but they allow of its being reached without dividing the muscles. A sharp-pointed instrument, carried perpendicularly to the axis of the trunk, on the internal border of the coracoid process, in the retiring angle existing between the clavicle and this eminence, would fall directly upon it, scarcely exposing the artery. In passing below the lesser pectoral, this plexus divides, sending off two branches, which, running beneath, and in front of the axillary artery, unite between this vessel and its vein, to form the median nerve.

In the *subpectoral space*, the nerves of the arm are commonly isolated.

The *median* remains internal. Towards the brachial region, it is sometimes found in front, and may easily be drawn backwards, when we tie the artery near the lesser pectoral, and, on the contrary, pushed forwards, when we would operate near the anterior border of this region. The vein or veins lie to its internal side.

The *musculo-cutaneous*, continuous with the anterior root of the median, gaining the posterior surface of the coraco-brachialis, which it traverses, is but very remotely connected with the artery.

The *circumflex* separates from the plexus behind, and a little above the inferior border of the subscapular muscle, over which it turns, to pass beneath the neck of the humerus. Its relations to the bone are such, that it may be torn in fractures, pro-

ducing serious mischief. In luxations downwards, it is also necessarily compressed by the head of the bone.

The *radial* or *musculo-spiral* is given off opposite the circumflex, these two cords sometimes arising by one trunk. Placed quite posteriorly, it descends, winding, beneath the humerus. Entering between the internal and posterior portions of the triceps, it may equally be stretched and torn in fractures, and compressed in luxations. It is not in immediate relation with the artery.

Internally and anteriorly is the *cutaneous* nerve, which, situated between the vein and artery, is sometimes sufficiently large to have been mistaken for the median.

The *ulnar*, more internal and posterior, is also covered by the veins. It is as large as the median, from which it is distinguished by its position, and because, in separating from its origin, it is also prolonged from the artery, by passing behind it.

The *thoracic* vary as to number. We distinguish two principal branches. The first leaves the plexus at the top of the clavi-pectoral space, proceeds obliquely forwards, downwards and inwards, gives off several filaments to the cellulo-adipose tissue, and terminates by a few branches in the greater pectoral. Passing in front of the vessels, it may be included in the ligature upon the artery. It is between it and the acromial artery that the axillary should be tied. It is crossed, in its turn, by the termination of the cephalic vein. The second arises a little lower, and passes behind the artery, subsequently between it and the vein, to run beneath the inferior border of the lesser, and supply the posterior surface of the greater pectoral muscle. In its course round the artery, this nerve is sometimes so intimately united that it is with difficulty separated from it.

The *subscapular* are still more uncertain as to number than the thoracic. All running backwards in the cellular tissue, and terminating in the muscle of the same name, they offer no important surgical consideration. They may be compressed, like the others, in luxations inwards, and by tumours developed in the axilla.

Posteriorly and internally, we remark the *posterior thoracic nerve*, coming from the supra-clavicular region, and placed on the axillary surface of the serratus magnus, to which it is distributed. If it were destroyed, respiration would be interrupted, as this is the only nerve supplying the serratus magnus. The posterior border of the shoulder would then project more backwards and upwards than usual, the scapula not lying close to the side of the thorax. A man aged twenty-six, strong and of good constitution, having been in this condition for six months, from falling with the cavity of his axilla upon the corner of a stool, was cured by the application of the moxa around his shoulder and thorax.

The *intercostal branches* of the axilla, leaving the chest, placed beneath the second and third rib, in front of the corresponding denticulations of the serratus magnus, ramify in the cellular tissue, lymphatic glands, around the basilic veins, and in the skin.

Remarks.—We may now easily understand the various forms of inflammations and abscesses of the axilla. Beneath the skin, the collection remains tuberculated, or in patches, and superficial, because the tissues are filamentous, and it meets with least resistance towards the skin. Near the aponeurosis it rather increases in breadth, as it occupies lamellous tissue, and is arrested, on one hand, by the fascia, whilst the subcutaneous tissue resists it on the other. The abundance of cellular tissue beneath the aponeurosis explains the rapidity and extent of deep abscesses of the axilla. The inferior portion of the clavi-axillary aponeurosis spreading over the skin, between the latissimus dorsi and pectoralis major, these abscesses frequently burrow a little lower on the side of the chest. Its superior portion would force them rather to follow the vessels and nerves, and pass into the supra-clavicular region and into the chest, of which I possess several examples, in the same manner that its rarefaction internally allows them easily to burst above the lesser pectoral muscle, and in the subclavian depression. Surrounded by muscles and fasciæ, these abscesses cause exquisite torture before they show themselves externally, or possess any evident fluctuation, and tend to invade the whole of the cellular tissue just described, as well as to perforate the skin. Hence the necessity of opening them *early* and *largely*. The glands, being nearly all situated between the aponeurosis, can only produce this species of abscess.

The *skeleton* of the axillary region belongs entirely to the shoulder, and should not delay us for a moment, excepting at its thoracic or costal portion.

The ribs present nothing more remarkable here, than what we have already seen in the costal region of the thorax. The second alone merits any attention, from the slight inclination of its external surface, and from its more superficial position. It is upon it that J. Bell recommends the axillary artery to be compressed, rather than behind the clavicle. We have already seen that this precept should not be followed. The others can but rarely be fractured, in consequence of the solidity and thickness of the surrounding parts. Nevertheless, this only extends to direct fractures, as those which depend upon pressure on the sternum may take place here as in other regions.

This accident is even more dangerous than elsewhere, on account of the organs contained in the axilla. Exostoses have this peculiarity, that, re-acting against the axillary plexus and vessels, they may be mistaken for aneurism, and more or less

interrupt the functions of the corresponding limb. In the example related by Mr. Mayo, the tumour was situated on the first or second rib, and produced obliteration of the axillary, and, at the same time, exceedingly strong pulsation of the subclavian.

Scapulo-humeral region.—Naturally limited, posteriorly, by the dorsal region, and in front by the subclavian depression, above by the supra-scapular region, and below by the margins of the axilla, the shoulder represents a triangle with its truncated summit looking forwards. Externally, it offers several eminences and depressions. We may easily feel its posterior border through the trapezius muscle. It is the same with its superior and inferior angles. Below is the rounded and thick border of the latissimus dorsi.

From above downwards, and from before backwards, we distinguish the coracoid process, an eminence corresponding to the spine of the scapula, the acromion, or clavicle; still lower, the projection of the infra-spinatus muscle. The deltoid and head of the humerus also form projections, generally very marked. Between these two last eminences is a kind of excavation, leading to the cavity of the axilla, which I shall name the *posterior deltoid groove.* Lastly, there is also a depression between the acromion and clavicle. The coracoid process is rarely fractured by direct causes, on account of the depression in which it is situated, and the projection formed in its neighbourhood, by the tip of the acromion, or the head of the humerus and clavicle. When the acromion overlaps the humeral relief in front, it is quite the contrary behind and externally. Thus, the least change in these relations is sufficient to decide that the scapulo-humeral articulation is in some way displaced. In some individuals, the extremity of the clavicle is so much elevated, or the acromion so much depressed, that a considerable projection results, capable of being mistaken for luxation or exostosis; so much so that I have frequently seen patients feign diseases, from which they never suffered.

This projection, observed principally in men sentenced to penal labour, may depend, as considered by M. Huguier, on the incessant pressure exercised by the clavical and acromion against each other. The skin, thicker at the top of the region, still more so behind than in front, and below, is never covered with hair. We here see no wrinkles, excepting those resulting from the arrangement of the papillæ, fleshy fibres, or prominences of the skeleton. The sebaceous follicles are not very abundant, but very large. I have seen them larger than the thumb, in which cases I touched them with nitrate of silver, after having incised them. This treatment, in two cases, was successful in a very few days. The pain attending furuncula, which here appear to differ but little from simple anthrax, depends upon its density and inelasticity.

The *subcutaneous tissue* encloses numerous venous and arterial

branches, but few nerves. The cellular tissue allows of great mobility in the skin, over the supra and sub-spinal fossæ. Abundantly supplied with fat over the deltoid, in some individuals, it is dense, and, as it were filamentous over the spine of the scapula, acromion, and clavicle, where it forms a complete bursa mucosa, placed in relation with the motion of the shoulder. As it is very intimately united to the skin, and easily separated from the aponeurosis, wounds not penetrating to the muscles may and ought to be united by first intention. The aponeurosis is formed by numerous layers, which terminate by uniting with those of the surrounding regions. The double lamella of the trapezius descends towards the superior border of the latissimus dorsi, which it envelopes before it blends with the brachial aponeurosis. In general, this membrane, thin over the muscles, where it resembles cellular tissue, is manifestly fibrous in the interval.

That which proceeds from the inferior border of the spine, and from the posterior margin of the scapula, divides, forming two intersections between the teres major, teres minor, and infra-spinatus. It is continuous with the preceding layer beneath the axilla, and splits opposite the posterior border of the deltoid. One of its processes, applied over that muscle, mingles with the superficial layer already described, and is lost in the aponeurosis of the upper extremity. The other remains beneath the deltoid, applied over the infra-spinatus, which it invests very firmly, accompanying it to the head of the humerus. It is thus prolonged between the articulation and the muscle, as far as the origin of the coraco-brachialis and biceps, which it embraces, to proceed into the axilla, where we have already studied it as the clavi-axillary aponeurosis.

Above the spine of the scapula, a third process binds down the supra-spinatus muscle, and attaches itself in front to the coraco and acromio-clavicular ligaments.

A correct knowledge of the aponeuroses is indispensable, when we would determine the situation and danger of abscesses or other affections, occurring behind the shoulder. In order exactly to appreciate the *muscles* of the scapular region, we should divide it into four portions: the supra-spinal, infra-spinal, axillary, and humeral.

In the first, the *trapezius*, inserted on the upper border of the spine of the scapula, also to the clavicle, is separated from the supra-spinal aponeurosis by cellular tissue, sometimes very thick, establishing a communication with the supra-clavicular and axillary regions. The *levator anguli scapulæ*, appertaining to the regions of the neck, raises the posterior angle of the scapula; therefore, if this bone were fractured transversely, it would cause separation of the parts. The *omo-hyoid*, a muscle belonging to the supra-clavicular region, inserted behind the coracoid notch, has but little influence on the action of the shoulder; on the

contrary, it there takes its fixed point to depress the larynx. In ascending, it leaves, between it and the coracoid process, a small triangular space, through which the supra-scapular vessels frequently pass, before entering the supra-spinal fossa. The *supra-spinalis* fills the fossa of that name, firmly bound down by aponeurosis. Beneath the acromio-clavicular arch, it lies directly over the articulation, before attaching itself to the tuberosity, and slides in loose fibro-cellular tissue, continuous with the axilla, beneath the clavi-axillary aponeurosis.

In the subspinal region, the aponeurotic portion of the trapezius conceals a very distinct synovial bursa; lower down, we find a portion of the latissimus dorsi, attached to, or sliding over, the inferior angle of the scapula, from which it also is separated by a bursa mucosa, and thus assists the trapezius in pressing the scapula against the thorax. In front, we see the scapular portion of the *deltoid*, the border of which becomes more and more isolated as it extends towards the humerus. Between this border, the trapezius, and the latissimus dorsi there exists a triangular space, in which the skin is only separated from the *infra-spinatus* muscle by aponeurosis. Beneath this space and the preceding muscles is the infra-spinatus. Attached to the fossa, which it fills, covered by the deltoid, it approaches the supra-spinal, and, like it, crosses the articulation, and is inserted in the tuberosity of the humerus, beneath the acromial arch.

As the supra and infra-spinatus muscles are enclosed in a species of sac, fibrous posteriorly, and osseous in front, abscesses forming in their substance can rarely find issue in any other direction than that conducting them to the axilla.

The *teres major* slides over the humerus in front of the triceps, which separates its tendon from the deltoid. The *teres minor*, a fasciculus detached from the infra-spinatus, mounts parallel to this latter beneath the deltoid; it may, therefore, be considered as an antagonist to the subscapular. The space separating it from the teres major, filled by cellular tissue and by semifibrous intersections, encloses the posterior branches of the subscapular vessels. Being external to the articulation, its anterior surface lies upon the long head of the triceps.

In the humeral portion, the *deltoid*, acting on the humerus, like a lever, raises the arm when it is free; but when the moveable extremity of the limb is retained by any force, it depresses the head of the bone, thus favouring luxation downwards. Moulded, as it were, around the articulation, it is manifestly separated, when the arm is hanging along the chest, by a space of which the sub-deltoid or clavi-axillary forms the roof, whilst the articular capsule constitutes the floor. Prolonged at the same time into the axilla, the supra-spinal and infra-spinal fossæ, this space perfectly accounts for the facility with which inflammations and suppurations extend from one of these points into all the others.

We remark on the humerus the extremity of the three portions of the *triceps*. The external, or that nearest the deltoid, extends, very frequently, as far as the tendon of the teres minor. The middle detaches itself by degrees, extending from the neck of the scapula, where it is inserted at about half an inch beneath the glenoid cavity. When the arm is fixed, this latter fasciculus acts upon the scapula in the same manner as the teres major. When the arm is raised, it represents a tense cord, opposing luxations downwards.

The *arteries* are derived from the *supra-scapular*, *transversalis colli*, *sub-scapular*, and *circumflex*.

The former penetrates the supra-spinal fossa mostly above, but sometimes beneath, the ligament, converting the coracoid notch into a foramen. The branches derived from it here, and distributed to the trapezius, supra-spinatus, levator anguli scapulæ, &c. muscles, are generally too small to require ligature in operations performed on these parts. One of these branches, passing beneath the acromial, behind the glenoid cavity, loses itself in the infra-spinatus, teres minor and major muscles.

The *transversalis colli*, arising from the same trunk, only gives its descending branch to the region of the shoulder. The third comes from the axilla. Passing by the subscapulo-humeral opening, it ascends between the teres minor and costa of the scapula. The largest of its branches immediately plunges into the subscapular fossa; the others proceed towards the acromion, and into the deltoid muscle. Finally, a large number supply the latissimus dorsi, teres major, &c.

A wound in the bottom of the scapulo-humeral or posterior deltoid fossa may thus give rise to alarming hemorrhage. It might be exposed by cutting parallel to the anterior costa of the scapula, on the external surface of the deltoid, and by dividing the posterior border of this muscle opposite the point where the teres minor and long head of the triceps cross. We should then have to divide skin, adipose tissue, the aponeurosis, fibres of the deltoid, and cellular tissue; the teres minor may be pushed backwards.

The *posterior circumflex* is almost completely distributed to the deltoid, anastomosing with the anterior circumflex, acromial, supra-scapular, and the preceding branch.

The communication between these branches maintains circulation in the arm, when we tie the subclavian or axillary arteries. The acromial, with the subscapular or circumflex, on the one hand, and on the other with the supra-scapular; the subscapular with the transverse cervical and external mammary; the latter, with the internal mammary and anterior thoracic, &c. are sufficient to carry the blood from the part above the ligature to that below it.

The *veins* follow the direction of the arteries, to which they generally adhere very firmly, and are much larger; their capillary

system is exceedingly rich. The lymphatics present nothing of any peculiarity; as everywhere else, they are ranged into two layers, one of which, superficial, passes to the glands in the axilla, whilst the second, more deeply seated, follows the veins and runs into the supra-clavicular and axillary regions.

The nerves are very numerous, but small. We here find the termination of the spinal, the supra-scapular, and circumflex, the principal nerve of the region.

As the spinal accessory ramifies in the trapezius, its division would interrupt the motions of elevation and abduction of the shoulder. The *supra-scapular*, coming from the supra-scapular region by the coracoid notch, furnishes filaments to the supra-spinatus muscle, descends to the infra-spinatus fossa, where it divides like the artery, and anastomoses with the subscapular and supra-acromial branches. Placed behind the glenoid cavity, it runs no risk of being injured either in amputation or luxation; but if the neck of the scapula be fractured, it may be implicated.

The supra-acromial, furnished by the cervical plexus, appears to be distributed to the skin, and the subscapular are of no surgical importance.

The *circumflex*, much more important, sometimes equals the size of the radial. Emerging from the axilla by the scapulo-humeral opening, enclosed in the same sheath with the artery and vein, it remains long applied on the bones, and does not entirely supply the deltoid muscle. From these relations, we may easily understand how pressure suspends nearly the whole of the movements of the arm in luxations. We may, also, conceive that in very high fractures of the neck of the humerus, it would be still more exposed to laceration, tension, and even compression, than in articular displacements.

The *skeleton* of the shoulder is composed of the whole of the scapula, the scapulo-humeral, and acromio-clavicular articulations.

The *supra-spinal fossa* is sufficiently thin for a sharp-pointed instrument to traverse it without difficulty, thus reaching the important organs in the axilla. Corresponding to the summit of the lung, we may here frequently apply the stethoscope, and the methods for percussion or oscultation.

The *infra-spinatus fossa* is not much thicker; but injuries here would produce different results. In fact, the brachial plexus, being more elevated, would very probably remain uninjured, and the instrument extend rather into the interior of the chest. The aponeurosis inserted into the whole of its circumference, and the infra-spinatus muscle, which is attached to its surface, would prevent all kind of displacement, and reduce the methods of treatment in these fractures to mere apparatus of support. A tumour of any kind developed in one surface would easily pass to the other; its necrosis may be followed by

suppuration between the subscapular muscle and internal surface of the bone. Trephining has been recommended, and even resorted to, in emptying this sac.

The *spine*, of which the triangular surface serves as a root to the posterior border of the scapula, allows the trapezius to slide over it, when its inferior fibres contract. The deltoid, which elevates the arm, and the trapezius, raising the shoulder, deriving thence, at the same time, their fixed or mobile point, are nearly always obliged to combine their action.

The *acromion*, a continuation of the preceding crest, rather inclined outwards, projecting about eight lines in front of the glenoid cavity, renders luxation of the humerus very difficult, unless there be fracture. In very muscular subjects, particularly those who exercise the arms much, the acromion, stronger, larger, ordinarily more curved below, is at times sufficiently near the head of the humerus to prevent amputation at the articulation. Its summit, as well as the external extremity of the clavicle, remaining cartilaginous until the age of fifteen, might be cut through without the assistance of a saw, in any required removal from disease of the acromio-clavicular vault. The same would be the case in amputation of the arm. I have frequently seen the acromion merely united by a simple cartilage to the spine of the scapula, in persons thirty years old. We may imagine that in such cases fracture, or rather separation of the epiphysis, would be easy.

The *coracoid process*, which completes the interior of the canal, traversing the tendon of the sub-spinal, serves as a point of support to the clavicle, when its sternal extremity is lowered. The coracoid and trapezoid ligaments, short, large, and very strong, prevent the clavicle being carried forwards or backwards beyond a few lines.

Fractures of the clavicle taking place between the two preceding eminences cannot be followed by any alteration as regards length, the acromial on one side, and the coracoid process on the other, completely preventing it. Between the spine of the scapula, the base of the coracoid process, and the clavicle, is the retiring angle, filled by the trapezius muscle. In front, we remark the little *coraco-acromial triangle*, closed by the ligament of the same name, by which we penetrate the articulation. The superior ligament and all the parts uniting the clavicle to the acromion are sufficiently dense to render luxation very rare, although the bones are united merely by a facette. We must, however, remark that the unfrequency of these displacements depends, also, upon other anatomical peculiarities.

The *clavicle* enters almost entirely into the thoracico-humeral region. Its superior surface, being only covered by skin, superficial cellular tissue, and some fibres of the platisma, may be correctly examined by passing the finger over the exterior surface. Thus, diagnosis of its fractures is extremely simple.

In front, the clavicle gives attachment to the pectoralis major at its internal half, and to the deltoid at its external third. Posteriorly, the attachment of the trapezius corresponds to that of the deltoid. The clavicle breaks most frequently where the attachments of the deltoid and trapezius muscles terminate; in fact, it there offers less resistance, its two curves uniting. In a fall on the shoulder, the weight of the body, and the resistance of the ground, act upon this point; a reason why fractures of the clavicle are nearly always oblique.

Fractures from direct causes commonly take place at the point of union between its two internal thirds, in consequence of its greater convexity here. The displacement occurs in the following manner; the internal portion is carried upwards by the sterno-mastoid muscle, to which the pectoralis major offers but little resistance; the external, on the contrary, being merely supported by the trapezius, is drawn downwards and forwards by the subclavian, deltoid, and pectoralis major. If the fracture occurs at the point first indicated, or more externally, it is possible that there may be but little displacement, because the trapezius and deltoid externally, the pectoralis major, subclavian, and sterno-mastoid internally, mutually neutralize each other. The muscular portion, destined for the adduction of the arm, having no longer any fixed point, the patients fear to carry the limb to the head, although they could almost accomplish it. In 1825 I saw a man, forty years of age, who three days previously had received a very oblique fracture of the right clavicle with considerable riding; he used his arm, and carried it to his head with the greatest facility. Another subject, aged fifty-eight, presented the same peculiarity in 1830; and since that period, by insisting upon the point, I have obtained the same results in all that came under my care. In 1831 a man, aged twenty-eight, came to my house with unconsolidated fractures of both clavicles, which did not at all interfere with the power or agility of the limb. A case is, also, related of a man in whom the internal half of the clavicle was wanting, and who enjoyed perfect use of his arm.* We may, therefore, under these circumstances, extirpate the clavicle, as performed by Mott, should the disease require it, or remove a portion, as related by Kuln. They, are therefore wrong, who say, with Desault, that fracture of the clavicle prevents carrying the arm to the head.

These facts support the opinion of those who maintained that fractures of the clavicle, in reality, require no other application than a simple supporting bandage; it must, however, be re-

* Mr. Travers, at the Medico Chirurgical Society, on the 28th November, 1837, related the case of a young gentleman, whose left clavicle he had removed in the June preceding. The entire clavicle had been removed, with the exception of a small portion of its sternal extremity; but he stated, that there was no falling forwards of the shoulder, nor any restriction in the motions of the arm. The account of this case may be seen in the Medical Gazette of 22d December, 1837.—H. H.

marked, that by this method we do not prevent the riding of the bones, and that the contraction of the axillary space may then be carried sufficiently far to produce compression of the vessels and nerves. In an adult whom I treated in 1829, the external portion had been pushed so far by the cause of fracture, that emphysema of the whole trunk supervened, and the numbness and swelling of the limb remained for a very long time, although I could not discover any fracture of the ribs.

The head of the humerus represents a hemisphere, larger, in proportion, in infants than adults. Its axis, directed obliquely forwards, outwards, and downwards, forms a curve in uniting with the humerus, and appears longer internally and posteriorly. At the point of this union, there is a circular fissure, increasing in depth towards this last situation, and which is the true anatomical neck, meriting the greatest attention, when we would remove the arm at the joint, and more particularly when we pursue the oval method. In fact, the knife should be carried perpendicularly upon it, to cut the capsule and tendons with certainty; otherwise, they would fold and roll beneath the instrument.

In some individuals, the head of the humerus remains long in a state of epiphysis. It may then separate or break, and we may imagine, that such fractures can scarcely unite unless in young subjects, as the fragment enclosed in the capsule, not being covered by periosteum, is completely separated from the living organs. The head of the humerus is much larger than the glenoid cavity; thus, without the muscles surrounding the articulation, the weight of the limb alone would be sufficient to produce luxation in paralytic individuals.

By taking its axis as a central point, we see that the chest would limit adduction before it could leave the glenoid cavity, and that the capsule, strengthened by the tendons of the infra-spinatus and teres minor muscles, presents an almost insurmountable resistance in this direction. Luxation into the infra-spinatus fossa, is, however, far from being impossible, as the annals of science possess nearly twenty examples of this accident.

Posteriorly, the motion is soon arrested by insurmountable obstacles. The supra-spinatus and deltoid prevent the head of the bone slipping forwards. If it should tend directly upwards, the capsule, strengthened by the coraco-humeral ligament and the coraco-acromial vault, does not allow it to leave the glenoid cavity. Should the head of the humerus be displaced above the coracoid process, as in the case cited by Dorsey, the capsule would be very much torn, or extremely relaxed. Nothing, on the contrary, limits adduction, and when the arm is elevated, the deltoid may assist it, in a very decided manner. The capsule, much thinner internally than externally and superiorly, is only sustained by the tendon of the subclavian, which tends

to push the head of the bone with more force towards the glenoid cavity, when dislocation is likely to occur. When the arm is elevated to a right angle with the trunk, the axis of the head of the humerus is very near the inferior border of the glenoid cavity. Then, the deltoid, pectoralis major, latissimus dorsi, and teres major become auxiliaries to the power of displacement, which, in reality, meets with no other opposition than that experienced from the capsule; luxation, directly downwards, is, therefore, admitted to be easy.

This theory is correct only up to a certain point; the tendon of the triceps and the upper part of the capsule render luxation directly downwards impossible. The subscapular and infraspinatus would allow the head of the bone to be placed downwards and inwards, outwards and backwards. Experiments on the dead body will prove this fact. Luxation in front occurs under two forms. Firstly, the head of the humerus, arrested, on the one side, by the tip of the coracoid process, and, on the other, by its fibrous investment, may remain with the groove marking its anatomical neck, placed on the edge of the glenoid cavity. This appeared to be the case in the subjects observed by MM. Physick, Cooper, Manec, Fisher, and myself, and which has been described as *incomplete luxation*. In these kinds of luxations, the head of the bone, in process of time, becomes grooved, and flattens the edge of the glenoid cavity, by embracing it. Secondly, the head of the humerus, escaping entirely from its capsule, passes beneath the subscapular muscle into the cavity of the axilla, giving rise to luxation downwards, or into the axilla. When the capsule yields higher up, the head of the bone slides between the subscapular muscle and scapula, constituting subscapular luxation. Pushed upwards and inwards, the head of the bone may be forced above or across the superior fasciculi of the subscapular muscle, and be fixed beneath the coracoid process and the clavicle. In this case, the humerus is so much raised, that, in consequence of the scapula revolving, the arm, measured from the tip of the acromial to the condyle, is often shorter than that of the sound side, instead of being longer, as was, at first, thought by MM. Malgaigne and Sedillot. This fact, which I first pointed out in 1834, and have since proved upon five different patients, has also been observed by Robert and others; it only occurs as an exception in axillary and subscapular luxation. Here, the dislocated limb is generally longer, as described by Celsus, Duvernay, &c.; but never so much as two inches, as they have (no doubt, inadvertently) advanced. Although in these cases the shoulder approximates to the thorax, the axis of the humerus does not the less represent a diagonal, which, with the depression of the acromion, either partly or totally effaces the lengthening, which we might à priori consider inevitable. We must also, remark, that, raised

to right angles on the trunk, the dislocated arm is always shorter than the other.

Posteriorly, the head of the bone may be arrested, at its cartilaginous fissure, by the border of the glenoid fissure, which I am convinced I saw occur in two patients. Although placed between the scapula, infra-spinatus muscle, and spine of the scapula, consequently below the superior point of the glenoid cavity, the head of the bone appears, in some cases, capable of producing a certain degree of shortening of the arm, in consequence of its inclination backwards, and the forced depression of the clavicle. In a word, the capsule is ruptured inferiorly, whilst the head of the bone always tends towards one of the fossæ of the scapula. We may conclude, from the preceding remarks, that the best methods of reducing luxations of the humerus consist in elevating the limb towards the side of the head, for axillary and subscapular dislocations, and extending it downwards, and, subsequently, horizontally, in others.

The tendons of the scapular muscles are so disposed, that, in fractures of the neck of the humerus, their action is mutually neutralized, and scarcely displaces the upper portion of bone. The subscapular, teres minor, and infra-spinatus together antagonise the supra-spinatus. The glenoid cavity, remarkable for its shallowness, compared with the size of the hemisphere rolling upon it, is much longer vertically than transversely, a peculiarity which should be borne in mind, in amputations at the joint. The *coraco-acromial* vault being nearly an inch above, there is a space of nearly two inches and a half between the tip of the acromial process and the base of the glenoid cavity, whilst, transversely, there is scarcely an inch.

Two general methods have been recommended for amputation of the arm at the joint. In one, the flaps are always parallel to the lesser diameter of the above-mentioned space; whilst, in the other, they are perpendicular to it. When we amputate, forming but one inferior flap, like Le Dran, or superior, like La Faye, or rather two, in imitation of Dupuytren, Garangeot, &c. the immense distance separating the base of these flaps renders union by first intention extremely difficult.

When we make an internal flap by pushing the instrument on the inner side of the humerus, from the summit of the acromion, behind the anterior border of the axilla, as indicated by Desault, next traversing the articulation, and forming the external flap, as we complete the incision; or, when we commence, on the contrary, with the external flap, and terminate with the internal, according to MM. Larrey and Roux, instead of completing the first, by cutting from within outwards, we penetrate, with Dupuytren, by a semilunar incision of the integuments, towards the back of the capsule. It is evident that we shall then

have two flaps, either of unequal or equal length, but which can be brought together, almost completely obliterating the acromio-glenoidal space. It would be the same with circular amputation, preferred by some English surgeons, and the oval, consisting of two incisions, the one anterior, the other posterior, extending from the tip of the acromion process, obliquely, to the two borders of the axilla, without uniting; thus avoiding the vessels and nerves.

The *bicipital groove* receives the tendon of the pectoralis major muscle on its anterior margin, and those of the latissimus dorsi and teres major on its posterior; insertions of importance as regards fractures and dislocations. If the fracture occurs beneath, and at the same time above the attachment of the deltoid, the upper portion of bone will necessarily be drawn inwards; if below, on the contrary, the superior portion would be free from the side, whilst the inferior, in its turn, would incline strongly towards the chest. In luxations, if the displacement occurs when the humerus is fixed, or from a fall, with its inferior extremity striking on some solid body, whether the cause be direct or indirect, it is evident that these muscles would act upon the bone as upon a lever, and that, being attached very near the head of the bone, they would draw it strongly inwards.

The bicipital groove, deeper and deeper as it ascends, is converted into a complete canal as it passes between the two tuberosities of the head of the humerus; by this means totally preventing displacement of the tendon during rotation of the arm.

In front, the humerus is rounded. The deltoid, which covers it without adhering, is separated from it by lamellous cellular tissue and the axillary aponeurosis. Its greater tuberosity receives the tendons of the supra and infra-spinatus, and teres minor. Posteriorly, is the insertion of the coraco-brachialis, which, in fractures of the neck, acts on the lower portion, in the same direction as the pectoralis major, but tending to produce displacement forwards. The lesser tuberosity, upon which the tendon of the subscapularis is attached, sometimes projects sufficiently to be mistaken for displacement of the head of the bone.

Beneath these tuberosities, between them and the body of the bone, we remark the *surgical neck*, the fractures of which are accompanied by peculiar dangers, presenting special indications. The circle formed by the circumflex vessels may be torn, and it is doubtless to the rupture of the vein that must be attributed the ecchymosis resulting. The nerve of the same name may equally be stretched or torn; paralyzing the deltoid muscle, and producing severe nervous affections.

The apparatus applied can scarcely act otherwise than upon the lower portion of the bone; conseqently, the common bandage for fractures of the humerus in general, and those of Le Dran and Desault, for fractures of the neck of the bone in particular,

are almost useless, whilst we may attain our object by placing a thick pad in the axilla, and fixing the arm to the trunk. I have always found this simple method successful, and may thus explain why. The lower portion of bone is drawn outwards by the stretched fibres of the deltoid, which, at the same time, prevents the upper one from being carried outwards or forwards. Thus, the muscular action, which had displaced the parts, is the means by which we may restore them to position, and perfect immobility is all that is required for cure.

A common danger, incidental to all amputations at the shoulder, is that depending upon the opening of the fibrous capsule. When inflamed, the pus may extend into the infra-spinatus, subscapular, supra-spinatus, and axillary fossæ, following the contour of the glenoid cavity.

We may imagine that, surrounded by parts of such importance as those of the axilla, the head of the humerus, if displaced for a long period, cannot always be reduced without danger. Thus, the extension to which it is necessarily subjected, has often produced rupture of the nerves, axillary artery, and even immediate death, as occurred in one of the hospitals in Paris. M. M'Kenzie says that he has succeeded at the end of six months. M. Sedillot was not less fortunate, after eleven, in a patient whom I saw. I reduced one after fifteen days, at the first attempt, without any difficulty, in a female aged seventy.

When the lengthening of the limb remains after the reduction of these dislocations, it depends neither upon thickening of the cartilage nor swelling of the synovial membrane, in the first place, because there is no synovial membrane in the glenoid cavity, and in the second, because the cartilage is not capable of swelling. The cause is found in the turgescence of the tissues enclosed by the capsule, and in the momentary paralysis of the muscles. Perhaps, as in the unfortunate case which I have spoken of above, instead of a complete reduction being effected, the capsule may have been folded by the head of the bone into the glenoid cavity.

The *scapula*, situated behind and on the side of the thorax, covering the six upper ribs, corresponds to the thickest and most spongy portion of the lungs. Thus, although padded by numerous and large muscles, we can, pretty correctly, hear respiration, among other points, over the supra-spinous portion.

SECTION SECOND.

OF THE ARM.

Strictly speaking, the arm comprehends all that portion of the upper extremity occupied by the humerus; but in regional anatomy it only extends from the shoulder, or axillary region, to

the elbow. It is conoid in fat individuals, and, especially, in females. Cylindrical, and more or less flattened internally and externally, it presents, superiorly, a triangular projection, limited, in front and behind, by two fissures, uniting at its apex, to form the deltoid depression. From this excavation, there extends another fissure, the *external bicipital*, large and superficial, and descending as far as the bend of the arm, on the external surface of the limb. It is upon it that blisters are applied. Another fissure, the *internal bicipital*, follows the internal surface of the arm, and extends from the cavity of the axilla to the same point, where it joins the preceding. Between and in front of these two grooves is a very marked projection, lost in the axilla and bend of the arm; this is the *bicipital eminence*. Posteriorly, the triceps, also, more or less raises the integuments, but does not form any important prominences.

We will consider the limb in a state of supination, and, first, examine its *anterior surface*:—

The *skin* is delicate and very extensible, especially internally. In the internal fissure, we may sometimes see the basilic vein. Extremely mobile, it allows simple wounds to unite by first intention.

The *subcutaneous tissue*, which may acquire very great thickness, encloses the nervous filaments from the musculo-cutaneous, internal cutaneous, and intercostal nerves.

The *aponeurosis* is thin and almost cellular in the median projection. More complicated than in the generality of regions, thick internally and externally, because all its lamellæ there unite, it forms a covering for the biceps. It also furnishes a second sheath for the artery and its accompanying veins and nerve, and within this secondary sheaths around each organ. Hence, the aponeurosis, in some degree, furnishes an investment to all the muscles, nerves, and vessels found in the brachial region, excepting the triceps and brachialis anticus, which adhere to the bone, from one side to the other.

Muscles.—The *biceps* furnishes the arm with all its anterior muscular portion. Its internal border serves as a guide in exposing the vessels. Free beneath the skin, it retracts considerably in amputations, the more so as it is commonly divided very far from its points of attachment. The extension of the fore-arm augments the projection. In contracting, therefore, it tends to bend the humerus forwards, and may, in fractures, displace the bones, at first, as regards their direction, and subsequently, their length. Thus, the fore-arm is kept bent during the cure of these accidents.

The *brachialis anticus*, hidden, in a great measure, by the biceps, beyond which it projects a little on each side, so that, internally, the artery lies upon it, is inserted on the whole of the anterior surface of the humerus, and also on the front of the fibrous septa attached to the margins of that bone. Superiorly,

it is thinner, and, as it were, bifurcated in a V, to embrace the apex of the deltoid. It is there, between the biceps internally and the triceps externally, that the *deltoid fossa* is situated, filled by cellular tissue and fat, and so disposed, that the muscles circumscribing it can neither move it nor slide upon each other. It is on account of this peculiarity, as much as from the abundance of cellular tissue, that we here apply caustics, &c. Adhering to all the points of the bone which it covers, and finding its moveable point on the ulna, this muscle opposes, instead of favouring, displacements in fractures of the inferior portion of the humerus. This disposition almost entirely prevents its retraction after amputation.

Arteries.—The brachial, enveloped in its sheath, is always accompanied by the median nerve, and the humeral vein or veins. Superiorly, the nerve is internal or in front; more inferiorly, it crosses it very obliquely, passes nearly always over the anterior surface, and only occasionally behind; inferiorly, it is almost always to its ulnar side.

Independent of its sheath, the median nerve and collateral veins, the artery, reposing posteriorly, from above downwards, on the humerus, the tendon of the coraco-brachialis, the front of the internal portion of the triceps*, and the brachialis anticus, may easily be compressed against the bone at its upper third. Accompanied by the coraco-brachialis, externally, afterwards by the biceps, it is separated from the triceps, internally, at first, by the radial nerve and internal collateral artery, subsequently by the ulnar nerve, which separates from it as it descends, lastly by the cutaneous nerves and basilic vein, enclosed in their sheath, and lying nearer to it above than below. In its inferior fourth, it has no relation with the triceps, the brachialis anticus then concealing its inner side. In front, and internally, it is covered by the aponeurosis. Sometimes, also, the belly of the biceps inclines more or less in this direction.

In middle-sized individuals, in whom the muscles are not very large, its pulsations may easily be felt along the internal bicipital fissure; therefore, to expose it, we must cut in the direction of a line drawn from the cavity of the axilla to the elbow, following the internal border of the biceps. To prevent any mistakes as to its precise situation, we must recollect that the median nerve is always the first cord met with in leaving the biceps.

The *superior profunda* commonly arises from the brachial, a little below the teres major; sometimes it is furnished by the subscapular, circumflex, &c. Immediately approaching the interstice, between the internal and middle portions of the triceps muscle, to enter the posterior region, it is occasionally very

* It does not, properly speaking, lie on the triceps at all, being, in the first place, separated from it by fat and the tendon of the coraco-brachialis, and, subsequently, by the brachialis anticus.—H. H.

large, and is the principal resource in re-establishing the circulation after the brachial is tied.

The *anastomotica magna*, presenting itself towards the middle of the arm, runs across the brachialis anticus muscle, before it gains the posterior surface, and follows the ulnar nerve, as the preceding accompanies the radial. Habitually small, it is sometimes very large, and may equal the size of the brachial. It must not be forgotten when we perform any operation on the internal surface of the arm, especially on the brachial artery.

The *nutritious*, met with towards the termination of the coraco-brachialis muscle, the tendon of which it traverses, slides obliquely over the humerus, immediately penetrating its own proper canal. When of an increased size, it may give rise to considerable hemorrhage, in sawing through the bone near the insertion of the deltoid. Its laceration accounts for the ecchymosis sometimes resulting in fractures, which cannot depend upon injury of the veins.

The *inferior profunda*, being also situated in the region of the elbow, will be studied there. The other branches, given off by the brachial, are too small and uncertain to merit much attention from the surgeon.

The brachial artery, sometimes *double* at its origin, is more frequently so at a lower point in the limb. The two trunks may then be of equal size; at other times, one is smaller, the other larger. This anomaly may give rise to fatal error, if we have to tie the artery of the arm in individuals thus formed. I have observed it twenty times, and there is not a pupil but has met with examples in his dissections. In November 1832, I found a variety sufficiently remarkable to merit notice. Arrived at the fold of the arm, the two trunks were united by a transverse branch, about an inch in length, and as large as a quill. Anel's method would have been unsuccessful in aneurism of either of these, as ligatures above and below would not have prevented the transverse branch carrying the blood into the sac; after opening which, according to the ancient method, we should find the hemorrhage continue, in spite of ligature of the extremities of the diseased artery. Another very singular disposition is that shown me, in 1827, by M. Bintot, who was then my prosector; after a certain course, the two branches crossed in a figure of eight; thus, before they reached the fold of the arm, the internal had beome external, and *vice versâ*.

Veins.—These are superficial and deep; the former are the *cephalic* and *basilic;* the others have been described with the artery.

The *cephalic*, parallel to the biceps and the external fissure of the arm, gradually inclines inward to the interstice separating the deltoid from the pectoralis major. Placed completely external to the aponeurosis in the arm, and inclosed in the deep processes of the subcutaneous tissue, it interposes between the

lamellæ of the *fascia brachialis* at the shoulder. It may be opened, if requisite, with a lancet, in all parts of its course, without leading to any danger, being accompanied merely by some filaments of the external cutaneous nerve of the arm.

The *basilic*, placed in the middle of the internal bicipital fissure, at first enveloped in processes of the superficial fascia, like the cephalic, subsequently leaves this layer, sometimes immediately above the elbow, at others only at the moment when it enters the axilla, to traverse the aponeurosis and join the deep veins. Whilst it is still merely cutaneous, the numerous branches of the internal superficial vein wind round it. Accompanied by the trunk of this nerve, enclosed in a peculiar sheath beneath the aponeurosis, separated from that of the artery by a septum, it is, as we may say, both superficial and deep-seated. Thus, its external inflammation may produce mere simple erysipelas below, whilst the same disease, occurring at its upper portion, would produce general swelling of the limb; may, for the same reason, determine the formation of abscess between the aponeurosis and integuments, and also produce them between the muscles, whilst the cephalic vein can only give rise to such accidents in the subcutaneous tissue.

The *lymphatics* abound in the bicipital gutters, where they are grouped round the cephalic and basilic veins. The cephalic, in particular, receives a very complicated chain, which remains in the subcutaneous tissue up to its entrance in the cavity of the axilla. It was on account of the great quantity of absorbents and cellular tissue found in the bicipital fissures, and on the whole of the anterior surface of the arm, that it was recommended to apply counter-irritants here.

The *deep lymphatics*, forming two or three bundles round the artery and vein, are interrupted, from the elbow to the axilla, by glands, the number rarely exceeding from four to five. We frequently find none, and when they do exist they are naturally but very small. It is necessary that we should exactly understand their position, as, in chronic enlargements, they may contract adhesions with the artery, and be mistaken for aneurism. I have twice found a single lymphatic gland above the deltoid fossa; in both cases they were the size of a pea, and the vessels converged towards them.

Nerves.—The relations of the *median* have been detailed in speaking of the artery.

The *musculo-cutaneous*, or external cutaneous, sometimes remains external to the artery, instead of perforating the coraco-humeral; in which case it may be mistaken for the median. Entering the sheath of the biceps, it quickly becomes external opposite the cephalic vein, from which, however, the aponeurosis separates it, at the lower part of the region.

Next to the median, the *internal cutaneous* is nearest the artery. Placed on rather an anterior plane, it follows the

external borders of the basilic vein, proceeds with it into its canal, leaves the aponeurosis at the same time, and furnishes a great number of filaments to the superficial layer in its course. It is sometimes so large, as at first sight to resemble the median.

The *ulnar* is placed on the internal side of the brachial artery, in front of the triceps muscle, by which it is enveloped nearly from its commencement, and which it traverses towards the middle of the arm to reach the posterior region, behind the internal condyle.

The *radial*, still more posterior and external, follows the direction of the superior profunda artery; that is to say, it winds round the humerus between the portions of the triceps, almost immediately abandoning the region in which it arose.

The size of the nerves of the arm would be exactly graduated in the following order:—1. Radial; 2. Median; 3. Ulnar; 4. Musculo-cutaneous; 5. Internal cutaneous.

The *intercostals* are entirely distributed to the superficial layer, establishing a certain sympathetic relation between the arm and the organs contained in the thorax; capable of explaining, to a certain degree, the revulsive action of blisters applied on the superior extremity, in diseases of the chest.

Much less complicated *posteriorly* than in front, the arm is also less important there. Superiorly, it presents a part of the deltoid prominence, and of the posterior fissure of the same name. It is convex and round in its whole extent.

The *skin*, thick, dense, wrinkled, presents numerous bulbs and a large quantity of sebaceous follicles, giving it an unequal and rough appearance, known by the name of *goose flesh*.

The *subcutaneous tissue* encloses but very few vessels and nerves, in consequence of the texture of the skin and the slight adherence of the cellular tissue. Pus here denudes the parts with the greatest facility, whilst it has difficulty in escaping externally; we should, therefore, open these abscesses early.

The *aponeurosis* here is generally thicker than on the biceps, but thinner than on the brachial fossa. Its fibres are mostly transverse; it is continuous, superiorly, with the latissimus dorsi, which may be considered as its extensor. Inferiorly it receives the fibrous intersection coming from each side of the humerus, and is everywhere a single membrane, except in approaching the internal intersection, where its laminæ separate to invest the ulnar nerve.

Muscles.—We only, properly speaking, find the *triceps*, the fibres of which, nearly parallel to the direction of the bone superiorly, are oblique from the median line towards the sides below. It is attached to the aponeurosis by means of very loose lamellous cellular tissue, which easily inflames, sometimes causing serious mischief. By its anterior surface it is attached to nearly the whole length of the bone, a circumstance of importance in fractures and amputations. In fact, when we amputate the arm according to the method of Vermule or Raviton,

the triceps adapts itself perfectly, whilst the biceps, entirely free in front, retracts, forming so round a mass that it is impossible to have a regular flap on this side.

In fractures below the deltoid, the triceps, being inserted on both the broken portions, is incapable of producing displacement; on the contrary, it tends, like the brachialis anticus, to maintain them in apposition. These kinds of fractures are rarely followed by much riding, unless they are very oblique, or the exciting cause has continued after the rupture of bone.

The very few arteries come from the humeral, and only deserve attention from the anastomoses which they form with the collateral branches of the fore-arm, re-establishing circulation after obliteration of the brachial. The superior profunda, winding round the humerus, at first between the internal portion and the long head of the triceps, subsequently in front of the latter, then on the external portion, to terminate near the condyle, gives off no branch sufficiently large to require ligature after amputation. In tying it, we must always recollect, that it is accompanied by the radial nerve.

The branches of the inferior profunda and internal collateral branches anastomose, frequently, with those of which we have just spoken, but are too small to require any notice. Thus, in amputating a few inches above the elbow, there is no absolute necessity for tying any but the brachial artery, and occasionally the internal or inferior collateral. In the centre of the limb hemorrhage might ensue, from the humeral, internal collateral, inferior profunda, and even nutritious artery of the bone.

The *veins* are disposed exactly like the arteries; none are superficial or susceptible of any particular surgical application.

The *lymphatics* are few, and nearly all pass to the internal bicipital fissure. They possess no known glands in this region.

Nerves.—The delicate *superficial filaments* almost all appertain to the internal cutaneous and costal branches. The external cutaneous rarely furnishes any on the outer side. The *ulnar*, the most remarkable, does not enter this region, until near the inferior third of the arm. Between the brachialis anticus and triceps, the aponeurosis furnishes it with a process, converted by the fibrous intersection into a canal, after which it is sufficiently superficial to be implicated in wounds. The *radial*, very large, giving many branches to the different portions of the triceps, exactly follows the direction and distribution of the superior profunda arteries, until opposite the origin of the long supinator, where it traverses the external fibrous intersection, to penetrate the anterior region between this muscle and the brachialis anticus. Lying immediately on the humerus, it is more exposed than the others to be torn in fractures, below the neck of the bone.

The *skeleton.*—The humerus in front slightly curved round, projecting superiorly, gradually widens as it extends. Between

the point of insertion of the latissimus dorsi, coraco-brachialis, or pectoralis major, we may compress the artery, which is there arrested by these muscles, and prevented rolling beneath the finger. It gives insertion, on its anterior surface, to the deltoid, coraco-brachialis, and brachialis anticus. Formed by the body of the bone, the skeleton of the arm is, consequently, the most contracted portion of the humerus, and is thence predisposed to fracture from indirect causes.

In those fractures which take place between the deltoid and teres major, the lower portion is drawn forward by the deltoid, and backward by the long head of the triceps; whilst the coraco-brachialis, latissimus dorsi, teres major, and pectoralis major muscles draw the superior inwards. It is in this class that displacement may proceed furthest, and that it most commonly occurs. Towards the deltoid depression, the upper portion is abandoned to the deltoid and muscles of the shoulder, which draw it outwards and forwards. The inferior portion is subject to the action of the brachialis anticus, which then takes its fixed point on the ulna. The biceps and long head of the triceps act, in this case, in inverse directions. Finally, at the lower portion, the two fragments being enveloped at the same time by the brachialis anticus and triceps, it is a rare circumstance to see the muscles alone produce displacement.

The weight of the limb so advantageously counterbalances the action of the muscles here, that fractures of the humerus are scarcely ever accompanied by riding, and are the easiest of any to cure. Surrounded by thick periosteum, this bone is one of the most exposed to incarcerated necrosis; one of those also from which we most successfully remove sequestra, and which is reproduced most perfectly by concentric developement, and of which unconsolidated fracture produces least inconvenience. A patient, observed by M. J. Cloquet, had lost the superior third, and yet retained the functions of the limb. In a lady of my acquaintance, its total and congenital absence interfered but little in the motions of the fore-arm. The removal of its head, which has so often been performed with perfect success, has always left the motion of the hand free, and sometimes even that of the greater part of the arm.

SECTION THIRD.

HUMERO-CUBITAL REGION.

In front, the middle portion of the upper extremity is called the *bend of the arm;* posteriorly, it is called the *elbow.* The different importance of these two regions establishes a very decided

line of demarcation, between them; and we will, consequently, study them separately, with the exception of the skeleton, common to both.

The *bend of the arm*, which may, to a certain extent, be compared to the ham, presents the termination of the bicipital eminence. Externally and internally, it offers two other muscular prominences, converging one towards the other. These are separated, superiorly, by the former, and inferiorly by a triangular depression, which is prolonged to the fore-arm, forming a simple fissure, resulting from the union of the two bicipital fossæ, distributed among the three preceding prominences.

The *skin* is delicate and mobile, especially in the middle groove and excavation. It also tends to slough, as in the front of the neck, from wounds or operations. The subcutaneous layer consists, as it were, of two lamellæ, one deep-seated, a kind of aponeurosis, containing the subcutaneous veins and nerves; the other, superficial, principally adipose, and varying considerably in substance. Thicker in the grooves than over the projections, it plunges, accompanying the deep median vein, between the pronator radii teres and long supinator muscles, to unite with the intermuscular lamellæ and cellular tissue surrounding the joint.

Aponeurosis.—In thin adults, the disposition presented by the aponeurosis at the bend of the arm is as follows: the superficial membrane of the biceps passes over the anterior surface of the external muscular prominence. The deep layer remains in the median excavation, where it is fortified by a lamella, coming from the tendon of the brachialis anticus. In descending, it elevates itself, passes between the radial and long supinator muscles on the one hand, and, on the other, over the anterior surface of the latter muscle, uniting with the superficial layer; quite below, its lamellæ approximate, containing the radial artery and nerve. The superficial membrane, stronger than without, passes obliquely over the internal muscular eminence. The deep process, still more thick, likewise comes from the internal and inferior portion of the brachialis anticus. In ascending, its fibres are oblique inwards and upwards, splitting to embrace the basilic vein. Lower down it is also double, and one of its processes ascends over the pronator radii teres, where it is continuous with the superficial division, whilst the other plunges between the muscles. The band detached from the tendinous portion of the biceps passes between these layers, at first without adhering to them, but subsequently joining them over the internal muscular prominence.

There is a kind of aponeurotic opening, resulting from this arrangement, which in some persons bears great analogy to that of the groin, which it also resembles in its dimensions, oval form,

in having its large extremity downwards, in its internal half circumference being more distinct than the external, in the vessels and nerves, finally, in the cellular lamellæ closing it, and sometimes preventing its being exactly distinguished. At the upper part of this opening, we see the tendon of the biceps, internally, the brachial artery, median nerve, and origin of the bicipital band, which there forms, the internal half circle, by its external border; lower down, the communication of the superficial veins with the brachial, the median nerve, the median basilic, and cephalic, passing in front. The falciform process of the biceps merits still greater attention, in relation to the artery, constantly crossed by its anterior surface. The vessel may receive a ligature below, before it divides into radial and ulnar. We might also place one above it, without being obliged to separate any thing but the cellular tissue.

Muscles.—In the *median prominence*, we find the termination of the biceps plunging into the cavity of the elbow. Between its tendon, the fibrous band given by it to the aponeurosis and the pronator radii teres, there exists a small triangle, in which are the brachial vessels and median nerve. The biceps in the natural condition tends, at first, to carry the radius outwards, and produce supination, and subsequently to flex the arm. In the anormal condition, luxations of the fore-arm backwards, for example, it antagonises the action of the triceps, and tends to produce flexion. In fracture of the upper third of the radius, the biceps endeavours to bring the superior portion forwards, and towards the median line of the limb; whence the necessity of then keeping the fore-arm bent.

The brachialis anticus, forming the bottom of the two lateral fissures, is covered in the middle by the biceps, and quite externally by the external muscular eminence. Internally, its anterior surface descends a little beneath the pronator radii teres. Its posterior surface, which covers the whole of the front of the articulation, without adhering to it, is separated from the humerus by abundant and loose cellular tissue, in which inflammation frequently produces deep-seated abscesses, quickly implicating the bone. Descending over the coronoid process, its tendon, very strong and thick, is not attached to it, as is generally described; it merely covers it, and is attached to the internal crest or anterior border of the ulna. Descending as far as a point corresponding to the tuberosity of the radius, this muscle acts as a flexor on the body of the bone. The apophysis evidently favours this action, by serving as a pulley to its tendon.

The *external projection* encloses the head of the long and short supinators, and two radial extensors; the first, the most important as regards surgery, inserted very high on the humerus, appears better disposed to promote flexion of the fore-arm than supination; which seems rather to appertain to

the biceps. When the humerus is fractured, beneath the insertion of the deltoid, the long supinator acts like the brachialis anticus upon its inferior portion; we may say the same of the long radial extensor. This latter and the short radial, being more particularly placed on the condyle, to which they are attached, and on the lesser head of the humerus, become the principal cause of displacement, in fractures of this portion of the bone of the arm.

The *short supinator*, attached to the condyle and ulna, investing the humero-cubital articulation, and nearly the superior fourth of the radius, then forms a power, on the one hand, to oppose luxations, and, on the other, displacements in fractures of the superior portion of this bone. In this direction, it is antagonised by the biceps, for the tendon of which its internal border presents a notch. The radial nerve runs into the posterior region of the fore-arm across its fibres.

The internal eminence, composed of the *pronator radii teres*, *flexor-carpi radialis*, *palmaris longus*, *flexor-carpi ulnaris*, *flexor-digitorum sublimis* and *profundus*, is the largest. Taking its fixed point on the humerus, and extending obliquely over the radius, its action almost entirely appertains to this latter bone, and produces pronation. In fractures this disposition is very disadvantageous; for instance, should the radius be broken above or below the insertion of the pronator radii teres, whether the fracture be transverse or oblique, it will always tend to obliterate the interosseous space, by drawing the fractured portion towards the ulna.

Arteries.—At the bend of the arm, the termination of the brachial descends obliquely outwards and backwards, generally dividing opposite the bicipital tuberosity. Enveloped in the lamellæ of the deep layer of the aponeurosis, it is covered by the superficial layer, by the fibrous band of the biceps, and, more inferiorly, only by cellular tissue. Corresponding in front of these membranes to the median basilic vein and internal cutaneous nerve, it lies on the brachialis anticus muscle, and subsequently on the tendon of the biceps, to which it sometimes adheres; whence forced pronation of the fore-arm prolongs it from the median vein. Internally, always accompanied by the median nerve, which may also lie posterior to it, it is in relation with the pronator radii teres muscle. Externally it corresponds to the biceps, crosses the internal border of its tendon, and terminates by being free in the median excavation. Hence if we would tie it, the operation must depend upon the point where we would expose the vessel. Above the articulation it is found between the median nerve, the concomitant vein, and biceps muscle. In the bend of the arm itself, after the incision through the skin and subcutaneous tissue, it is only covered by cellular tissue. Beneath the band of the biceps, the artery, nerve, and tendon are very close to each other, although always

in the same relation. The aponeurosis, properly speaking, only exists in front of them. Finally, a little higher, we must divide the superficial division of the aponeurosis, and the membrane of the biceps.

As the brachial artery may bifurcate higher than has been stated, it is safer to apply a ligature above the elbow than in the bend of the arm, even should the position of the disease allow of selection. When this bifurcation occurs on the tendon, or below, it is a natural arrangement, but when higher, or in any other point, it is an anomaly. In the latter case, the two branches may lie side by side, and enter the bend of the arm together; the median nerve also may separate them, or the external pass over the tendon of the biceps, to place itself beneath the supinator muscle, and form the radial, without descending to the bottom of the median excavation, whilst the internal runs, as usual, beneath the pronator to form the ulnar; a circumstance which may lead to danger, if phlebotomy is practised carelessly. It may also happen, that the internal branch is considerably separated from the external, and that, instead of plunging beneath the corresponding muscular eminence, it places itself in front, to constitute the ulnar, which, then subcutaneous, is generally merely the ulnar recurrent extraordinarily developed.

The *ulnar*, which appears the continuation of the preceding, soon dips beneath the internal muscular eminence, traverses the pronator radii teres, passes obliquely inwards, and places itself between the superficial and deep flexors. Thus, it would be difficult to expose this vessel at the bend of the arm in the normal distribution, and, should its obliteration be required, it is safer and more sure to proceed directly to the brachial.

The *radial*, generally smaller than the ulnar, at first very deep-seated, raises itself a little outwards and forwards, beneath the supinator longus, to follow the radial fissure of the fore-arm, consequently becoming more and more superficial as it descends. Immediately beneath its origin, it corresponds to the opening in the aponeurosis, and is separated from the radius only by the supinator brevis, tendon of the biceps, and cellular tissue. Anteriorly, several fibro-cellular lamellæ and the superficial fascia prolong it from the skin. Hence, we may expose it on the internal border of the pronator radii teres; but the operation would be rendered difficult from the projection of the muscles, by the presence of the medio-cephalic vein, and by that of the external cutaneous nerve, which is often obliged to be divided. Beneath the aponeurotic opening, placed on the pronator teres, between two thin fibrous lamellæ, it is accompanied, internally, by the radial flexor, and, externally, by the long supinator, the internal border of which ordinarily covers it.

As the *inter-osseous* arises from the ulnar, at the moment when it enters between the two layers of muscles, it would scarcely be

possible to tie it. It is, moreover, too deeply seated to be frequently wounded.

The *anterior radial recurrent*, arising, most frequently, from the trunk of the brachial, internal to the tendon of the biceps, over which it winds to enter the external fissure of the region, passes, as it ascends, between the two portions of the radial nerve, and anastomoses with the superior profunda.

The *internal recurrents* come from the ulnar. The anterior ascends in front of the condyle, and anastomoses above it with the inferior profunda. The posterior runs between the flexor sublimis, profundus, and ulnar flexor, to pass behind the humerus.

Finally, the *inferior profunda*, furnished by the brachial, commonly detaches itself from the trunk, at about one or two inches above the internal condyle. It is by means of its anastomoses with the recurrent arteries that the circulation is re-established in the fore-arm, when the blood cannot pass through the humeral. I have already observed, that it may replace the ulnar; then being very superficial. A friend of mine has this disposition so evident, that the pulsations of the artery may distinctly be seen through the skin, from the inferior third of the arm to about the middle of the fore-arm.

Veins.—The *cephalic*, placed on the external muscular eminence, as it passes from the anterior surface of the supinator longus, over the side of the biceps, receives the median cephalic and anterior radial. It is accompanied by the external cutaneous nerve, from which it is separated in the arm, near the condyle, by the aponeurosis. Thus, as regards accidents to the nerve, bleeding from the cephalic vein is less dangerous than from the others, and these accidents would be less likely to occur the higher we operate.

The *basilic*, situated to the ulnar side, passes in front of the condyle to arrive at the internal bicipital fissure. At first superficial, like the preceding, it becomes gradually deeper as it ascends. A little above the condyle, in entering the fissure, it dips between the layers of the aponeurosis, whence it derives a sheath. The cutaneous nerve, enclosed in the same sheath, is almost always placed to its inner side, above the muscular eminence.

The *median*, decidedly the most important in a surgical point of view, lies mostly at the bottom of the region, very frequently inclined over the external eminence; sometimes, also, more internally. Nearly always single as far as the aponeurotic opening, it there divides into three branches. One, very short, which M. Berard calls *perforating vein*, runs to empty itself immediately into the deep veins, like the internal saphena into the crural. The two others remain superficial, follow the two lateral fissures, and pass, one to the basilic, the other to the cephalic, so that, in

the normal distribution, they resemble a Y; whilst joining the two trunks receiving them, they represent an M.

The *median basilic* consequently runs along the external side of the internal muscular eminence. Becoming gradually deeper seated as it ascends, it crosses the artery very obliquely. This direction, however, is liable to numerous variations. In some individuals, the vein is nearly parallel to the artery; in others, on the contrary, it crosses it nearly at right angles. In the latter case, happily the most common, we run but little risk in practising phlebotomy, when the puncture is made near the extremities of the vessel. In the other the danger is nearly equal, whatever point we may select. In front of the tendon of the biceps, and below its falciform process, these vessels are only separated by lamellous cellular tissue, which forms a layer, varying in thickness with the degree of em-bon-point. Above, the median basilic being separated from the artery, at first by the process from the biceps, subsequently by aponeurosis, the relations of these vessels differ but little, whether in fat or thin persons, inasmuch as the fat always accumulates between the vein and skin, and not between the former and the aponeurosis, nor between the latter and the artery. We should, however, remark that, in thin individuals, the aponeurosis is, as it were, attached to the corresponding walls of the vessels; in which case the safest method would be to introduce the lancet very obliquely, and only cut the vein on its anterior half.

The artery being bound down on the tendon of the biceps by the aponeurosis, or fibro-cellular tissue, its depth is considerably augmented by excessive pronation. As the tendon recedes, the three muscular eminences project, rendering the veins more superficial. The ancients, therefore, prescribed this position with the intention of avoiding the puncture of the aponeurosis and tendon; but it is now known that the serious symptoms, sometimes observed, should be referred to other causes than wounds of the fibrous elements of the region. All that can be said upon the subject is that, by puncturing the aponeurosis beneath the vein, we may, under certain circumstances, cause inflammation of the deep-seated cellular tissue, producing a kind of constriction, and more or less obscure phenomena.

The median cephalic, mostly a little larger than the preceding, mounts outwards in the radio-bicipital fissure. The further from the artery the more it approaches the cephalic; it may, in its normal distribution, be opened without danger at any point of its course. The tissues supporting it being less solid, less resistant than those beneath the basilic, we occasionally have some difficulty in stopping the blood, and the same thing may and does occur to any of the others, notwithstanding the thumb is placed below the opening. This arises from the median being compressed below its division, and the blood returning by its deep branch. It results from these considerations, firstly, that

bleeding is more easy on the internal median vein, but more dangerous, than on the external; secondly, that, if necessary, the operation may be performed on all the veins at the bend of the arm; thirdly, that, when these vessels are distinct and voluminous in thin subjects, they easily roll under the skin, in consequence of the mobility of the cellular tissue; fourthly, that, when, in fat individuals, it is sometimes very difficult to perceive or feel them, they are fixed, and further from organs of importance; fifthly, that the instrument (*flammette*) used by German surgeons, applied on the median basilic, would be dangerous, on account of the proximity of the artery, and that, on the cephalic, it will frequently fail in opening the vein in consequence of the suppleness of the subjacent tissues; sixthly, that effusion occurs most frequently in thin individuals, from the facility with which the parts slide one over the other, thus drawing the opening of the vein beneath the integuments.

There are as many *deep-seated veins* as arteries, and very frequently there are more. The radial, for example, is often double; the ulnar sometimes presents the same disposition, as also the brachial. It is at the spot where the two former unite to form the latter, that it receives the communicating branch of the median. When there is only one vein for each artery, the radial is placed within and the ulnar without; the humeral is also most commonly external, but sometimes in front, and even internal.

Lymphatics.—The superficial are much more abundant than the deep-seated. In both situations they accompany the vessels; the veins in particular. Some are sufficiently large, especially in the internal fissure, for their division, in bleeding, to cause effusion of a certain quantity of lymph. They inflame and swell very easily, when pus, &c. forms in the tissues through which they pass. Thus, after phlebotomy, they are frequently the primitive seat of dangerous inflammation. Their glands are placed in the internal bicipital fissure, in front, and above the condyle; we generally find three, four, and even five. Placed between the cellular layers and deep aponeuroses, they may swell considerably in suppurations of the hand and arm, in consequence of inflammation, or absorption of poison, as in dissecting wounds, for instance.

The *nerves*, like the vessels, are superficial and deep. Among the former the largest, the *musculo* or *external cutaneous*, disengages itself from the aponeurosis, on the external side of the biceps, at about an inch above the articulation, and divides a little below. Its branches mostly follow the veins, uniting to form the cephalic. We have already seen, that the largest runs along the radial side of the common median.

The *internal cutaneous* lies in the ulnar fissure, and its branches, smaller than those of the preceding, are distributed around the basilic and median veins. The latter are, likewise, two in number. The radial, placed between the brachialis anticus and

supinator longus, subsequently between the biceps and the long radial extensor, divides in arriving at the joint. Separated from the brachial artery by the brachialis anticus, and biceps muscles, it is too far from all veins to run any risk in phlebotomy. Its posterior branch runs outwards, passes between the short radial extensor and supinator radii brevis, traverses the fibres of the latter, and penetrates the posterior region. Being very close to the head of the radius, winding over it, it may be stretched or compressed, in luxations forwards of the humeral extremity of this bone. The other, appearing the continuation of the trunk, raises itself a little to descend parallel to the length of the limb, behind the supinator longus, and soon along the side of the radial artery, from which it is furthest at its origin.

The *median*, almost constantly situated on the ulnar side of the artery, reposes in front of the brachialis anticus muscle, and descends into the cavity of the elbow, along the inner side of the tendon of the biceps, covered by the radial margin of the internal muscular eminence.

Traversing the pronator radii teres muscle, to place itself in front of the deep flexor, it lies behind the radial artery, or, rather, between it and the ulnar. The median gives off several branches as it passes beneath the muscular eminence, and, before leaving the region, it furnishes the *inter-osseous* and irregular branches, which sometimes follow the ulnar. From this disposition, although rarely injured in luxation, it may be wounded when we open the basilic vein. In the operation for aneurism, it may be mistaken for the artery, giving rise to embarrassment when the pathological condition of the parts produces displacement, &c.

Elbow.—Externally, the elbow presents three manifest eminences, the *external condyle*, *internal condyle*, and, in the middle, the *olecranon*, a little nearer the internal than external condyle. In extension, the olecranon offers but a slight projection, whilst, in flexion, it appears very much elongated, and is below the articulation. This eminence is prolonged upwards, under the form of a flattened cord, represented by the tendon of the triceps, and, inferiorly, by means of the ulna. Whatever may be the position of the limb, the internal condyle is equally prolonged upwards by the internal intermuscular septum, and, inferiorly, by the extensor carpi ulnaris muscle. The external is less distinctly continued by the corresponding border of the humerus. We may recognize, immediately beneath this latter, first, a transverse fissure, corresponding to the articulation, and, secondly, the head of the radius, which may easily be felt, rotating in its fibrous ring.

The eminences of the elbow are separated by two fissures. The internal, much the deepest, passing between the olecranon and internal condyle, is insensibly contracted above by the gradual

approximation of the internal portion of the triceps and internal intermuscular septum. It is here that we find the ulnar nerve. The external separates the external condyle from the olecranon; shallower and much less regular than the preceding, it is almost immediately lost behind the tendon of the triceps. A correct knowledge of these facts is of the greatest importance, when we would establish the diagnosis of fractures and luxations of the elbow.

The *skin*, thicker than in the bend of the arm, reddish, and thrown into folds, in some individuals, above the olecranon, encloses a large quantity of sebaceous follicles.

The *subcutaneous layer*, composed of lamellous tissue, very loose behind the triceps, ordinarily encloses, beneath the articulation, the termination of the posterior radial and ulnar veins, and branches of the muscular and internal cutaneous; also, of the radial nerve.

Over the olecranon, the cellular tissue becomes condensed, so as frequently to form a true *bursa mucosa*, the size of which varies considerably. Always enclosing a small quantity of fluid in the normal condition, it becomes entirely filled from the least blow, forming a tumour beneath the skin. It may also be distended by small fibrinous grains, assembling by dozens. A patient, who had one of these tumours on each olecranon, in 1824, was quickly cured by M. Bougon, who incised them largely. M. A. Berard found a similar cavity over the internal condyle.

As this tissue is very mobile, divisions of the skin of the elbow unite by first intention, and in wounds with loss of substance, their lips are easily brought in apposition by the puckering caused from the adhesive action of the tissues, and the cicatrix is rarely very large, when the limb is strictly kept in a state of distension.

Behind the tendon of the triceps, the *aponeurosis* is considerably thinner, and, as it were, transformed into cellular tissue, so that, over the median line, we no longer meet with it. Before reaching the internal intermuscular septum, it splits to envelope the ulnar nerve, and thickens opposite the olecranon, whence it detaches a kind of band, which is inserted into the internal condyle. More inferiorly, it arises from the posterior border of the ulnar, extending inwards, over the ulnar extensor muscle.

Muscles.—Above the bony eminences, the triceps alone exists; its fibres terminate in the internal fissure. Its external fasciculus, on the contrary, is continuous with the anconeus. Its tendon is inserted on the olecranon, in such a manner that, in flexion, it draws upon the ulna at right angles, whilst in extension it acts parallel to its length; thus, the inclination of the fore-arm backwards would be difficult, even if this eminence did not abut against the humerus. Inserted, not upon the superior surface of the apophysis, but rather behind, it thus favours the

formation of a small *bursa mucosa*, which I have sometimes met with between its deep surface and the articulation on the base of the olecranon.

Inferiorly we find, first, internally, the flexor carpi ulnaris, the two attachments of which to the olecranon and internal condyle, are united by a fibrous arch, in front of which lies the ulnar nerve; secondly, externally, the short supinator muscle, the origin of the common extensor, the extensor minimi digiti, the extensor carpi ulnaris, and the anconeus, so disposed that the head of the radius, almost uncovered, beneath the skin between them and the external muscular mass of the fold of the arm, can only be examined properly at that situation.

The *arteries* form two principal arches; the external derived from the anastomosis of the posterior radial recurrent, coming from the inter-osseous, with the termination of the superior profunda artery, is deeply seated between the muscles, behind the external condyle and the supinator radii brevis. In fractures of the external condyle, and in luxations, it may be ruptured, producing considerable ecchymosis. The internal results from the anastomoses of the inferior profunda with the posterior ulnar recurrent. Its branches ramify behind the internal condyle, and anastomose, in their turn, with those of the preceding, and with the arch placed at the anterior surface of the elbow. In aneurisms, or when the brachial artery is obliterated, these anastomotic arches sometimes become very large. A division of the soft parts, in the region of the elbow, may then be accompanied by alarming hemorrhage, and should we be obliged to amputate close to the joint, we should have to apply a large number of ligatures.

The *deep-seated* veins accompany the arteries, and are distributed in the same manner. The superficial vary much as to number, and still more in disposition. Surrounded by a small number of nervous filaments, they may be opened in bleeding; but they are rarely resorted to, because the anterior veins are always more distinct, and more easily attained.

Lymphatics.—We here find no glands; the vessels are few, the superficial passing to the bend of the arm. The deep-seated following the arterial arches, or traversing the inter-osseous space, run equally to the anterior region.

Nerves.—Some filaments and the posterior branches of the internal and musculo-cutaneous nerves ramify in the superficial layer. One branch of the radial descends behind the intermuscular septum, and follows the tract of the great muscular artery of the arm. The posterior branch of the radial, also, furnishes several ascending twigs beneath the joint, and ramifies principally in the superficial muscles. The principal nerve is the ulnar. Applied upon the internal intermuscular septum between the aponeurotic processes, it descends in the internal gutter, and behind the condyle is only covered by skin and aponeurosis.

On it depends the numbness experienced in the two internal fingers, when we strike the elbow against a solid body. In front of the flexor carpi ulnaris muscle, it gives off some unimportant filaments, and soon enters between the flexor muscles of the fingers.

Skeleton.—In the humero-cubital region, the skeleton comprises the inferior fifth of the humerus, and the superior fifth of the bones of the fore-arm.

The *articulation* presents three fissures and four processes in front, covered by a fibrous layer. The median fissure, which receives the coronoid process, is covered by the brachialis anticus, and corresponds to the brachial artery, median nerve, and to the strongest points of the ligament of the articulation. The internal, existing between the trochlea and internal condyle, is not articular, and is covered by the origin of the ulnar mass of muscles. The external, lying on the superior extremity of the radius, is concealed by an almost isolated fasciculus of the brachialis anticus muscle. Of the four processes, one formed by the condyle, or lesser head of the humerus, and surmounted externally by the external condyle, is hidden by the external mass of muscles; that which follows represents a sort of crest, which rolls upon the ulna, and even the radius; the third, very large, is the trochlea; the internal condyle forms the fourth, which is thrown strongly backwards. Above these various points, the humerus presents a kind of transverse fissure, depending upon its pulley-like surface being raised anteriorly. Upon this the knife frequently falls when we have introduced it too high in amputation at the joint; but we avoid this mistake by taking the precaution to conduct the instrument from one condyle to the other, in a line a little inferior to them. In this gutter are two fossettes; one, small and shallow, above the external humeral fissure, receives the front of the head of the radius, in forced flexion of the fore-arm; the other, very large and deep, receives the coronoid crest. Beneath the articulation, the ulna at first presents the coronoid process, which, curved more or less on the humerus, strongly opposes luxation. When we amputate at the joint, we should vainly endeavour to introduce the knife without lowering it. Its anterior surface inclines downwards, and forms another curve, with its concavity looking downwards; beneath which the brachialis anticus is attached, and where the inferior extremity of the humerus lodges in its dislocation forwards. It is at this point, and especially in the radial and olecranon excavations of the humerus, that there exist small patches of synovial cellular tissue; inflammation of which, whether chronic or acute, is often the commencement of serious diseases of the articulation.

The *radius* in this region presents its head enveloped by the annular ligament, and all the extensor muscles, its neck, the bicipital tuberosity, and the commencement of its body. The

condyle of the humerus, in luxation forwards, becomes placed upon its neck. Between the ulna and radius, above the bicipital tubercle, is a space, allowing the limb to be traversed from before backwards, without interfering with the bone.

Posteriorly, the *humerus* offers the posterior portion of the fissures and processes, already described in front. Above its articulating surface, we remark a deep cavity, in which the synovial membrane is prolonged, and which receives the olecranon process during extension. It appears that upon the degree of depth of this cavity depends the power possessed by some individuals of carrying the fore-arm so far backwards as to exceed the axis of the limb. Its floor, frequently very thin, corresponds to the coronoid cavity, and is sometimes completely perforated. In flexion, the cavity being only covered by soft parts, the triceps and fibrous membrane may be penetrated, from behind forwards, with a pointed instrument, and the brachial artery, median nerve, &c. wounded.

Oblique fractures easily extend into the articulation, and may be of two kinds. In the first place, the solution may occur from without inwards, in which case the condyle and tuberosity, which it surmounts, constitute the inferior or external portion; in the second place, from within outwards, comprehending the pulley of the bone and internal condyle, in the internal portion. In the former case, the posterior muscles of the fore-arm tend to draw the condyle downwards and backwards; in the second, the trochlea is drawn downwards and forwards by those of the anterior surface.

Remarks.—The *ulna* is covered, internally, by the flexor-carpi ulnaris, and, externally, by the anconeus. Its posterior border, subcutaneous, is connected to the humerus by the internal lateral ligament, which bifurcates as it proceeds from the condyle to be inserted into the olecranon and coronoid process. The olecranon, an important part of the elbow, is carried backwards in flexion of the limb. In this position a pointed instrument from behind might easily penetrate the articulation. It often projects backwards, especially in robust individuals, like a very prominent pyramid, liable to be mistaken for disease.

Externally, the radius is sufficiently superficial for its fractures to be recognized with facility. The lesser supinator almost entirely envelopes it. Its luxation, the frequency of which M. Briot has demonstrated, and which has fixed the attention of MM. Chedieu, Martin, Dugés, and subsequently of Sir A. Cooper, who especially mentions that occurring forwards, is, whatever they may say, more easily effected backwards than in any other direction; firstly, because the articulation is less supported posteriorly; secondly, because the action of pronation is more natural than that of supination; thirdly, because when

this action is forced, the radius revolves over the ulna, and passes behind the humerus.

The synovial membrane of the elbow is so disposed, that, in diseases of the articulation, it can only swell towards the olecranon fissures, posteriorly, and the bottom of the excavation of the fold of the arm anteriorly.

We may now understand the difficulties attending the removal of any portion of the bones of the elbow; however, as this operation has several times succeeded, as it preserves the fore-arm and the functions of the hand, the difficulties of its execution are not sufficient to proscribe it.

The ulnar nerve should be avoided, that is to say, disengaged from its sheath, and carried in front of the condyle, as recommended by Dupuytren, before we attempt to remove the extremity of the bone. Should the disease require it, we may, at the same time, remove the extremities of the ulna and the radius. But the anatomical disposition of the organs proves, that the operation would then present much less chance of success, completely doing away with the possibility of subsequent flexion of the fore-arm.

SECTION FOURTH.

OF THE FORE-ARM.

The fore-arm, comprised between the elbow and wrist, is like an inverted cone flattened on its two surfaces. This form varies with the age, size, and position of the limb. In infants, as in fat persons, the cone is more regular; in thin persons it is flattened and almost as large inferiorly as superiorly. Its anterior surface, in flexion and pronation, is more convex than in extension and supination.

Anterior region.—In pronation, the inferior portion of the palmar surface of the fore-arm looks backwards; superiorly, it is turned inwards. We here remark, superiorly, the continuation of the two muscular prominences of the fold of the arm, and the fissure separating them; in the middle, these two eminences are almost blended, and the fissure is scarcely distinct. Approaching the wrist, we may perceive or ascertain by the touch, the eminence formed by the flexor carpi ulnaris muscle, a fissure in which the ulnar artery may be felt; a second projection, formed by the flexor digitorum muscles; a third, produced by the tendons of the palmaris longus, and flexor carpi radialis, and which is much augmented by flexion of the wrist upon the fore-arm, the fingers being extended; a fissure, larger and more marked than the first, in which we distinguish the radial artery through the integuments; lastly, a fourth

eminence constituted by the radius. There are, also, numerous veins, raising the skin, and forming a more or less complicated plexus, along the whole of this region.

The *skin* offers all the characters of that of the bend of the arm.

Subcutaneous layer.—The lamellous tissue composing it forms a more or less thick, and always very mobile, layer, allowing the skin to be raised without dissection in amputations. Among children and women, its thickness, then more considerable, gives the fore-arm the rounded form distinguishing persons of that sex. As it encloses the veins, these vessels are always more evident in man than in woman.

The *aponeurosis* furnishes a sheath to the flexor carpi ulnaris muscle, and, also, another to the long supinator. Beyond the supinator, its two lamellæ approximate, and mingle with the aponeurosis of the posterior region. Inferiorly, the two portions of the flexor carpi ulnaris unite before their insertion into the ulna, in the same manner that those of the long supinator join to attach themselves to the radius; thus, between these two muscles, the aponeurosis, binding down the other tendonous and fleshy organs, merely forms a single lamella.

The *muscles* are numerous, and arranged in two layers. The former comprehends the flexor carpi ulnaris, the flexor minimi digiti, superficial flexor, palmaris longus, flexor carpi radialis, and pronator radii teres. In the second, we find the deep flexor, the flexor longus pollicis, and the pronator quadratus. In front of the radius, and superiorly, we see the termination of the supinator radii brevis, the radial extensors, and long supinator. The flexor carpi ulnaris and flexor sublimis separate as they descend, and give rise to the internal fissure; the supinator radii longus and palmaris longus, also, divide to form the external groove. The radial extensors turn outwards, and pass into the posterior region. The deep flexor, prolonged to the ulna, beneath the coronoid process, is also attached to the radius beneath the bicipital tuberosity. The flexor of the thumb lies in front of the radius, and receives a small round fasciculus from the coronoid process. The pronator quadratus, placed transversely, in some fractures, tends to obliterate the inter-osseous space. The upper part of all these organs is fleshy, whilst below the fibrous element predominates. The tendons, at first close together, immediately divide. Always united by a kind of fibro-cellular or synovial membrane, inflammations are extremely dangerous; hence, wounds of the upper part of the fore-arm are much less serious than those of the lower.

Arteries.—The *radial*, parallel to the radius, is covered in its superior portion by the internal border of the long supinator, and the two layers of aponeurosis. In the other half, the aponeurosis alone is in front; but its two portions are generally united. It lies on the tendons of the supinator brevis and

pronator teres, subsequently on the radius and pronator quadratus. Externally, we see, at first, the radial and long supinator muscles, and, next, the tendon of this latter alone. Enveloped in a cellular sheath, which at the same time encloses the two collateral veins, the radial artery is more superficial inferiorly than superiorly.

We might expose this artery with certainty, by cutting, in the direction of a line extending from the middle of the space, separating the tuberosities of the humerus, and terminating internal to the styloid process. When the radial fissure is distinct, we may proceed in the same manner. The median vein frequently presents itself in the direction of the wound; but it need not be confounded with the artery, if we remember that the aponeurosis separates them. The radial artery is sometimes subcutaneous; this anomaly would render injuries, however superficial, dangerous. If the limb should be swollen from any cause, and we are obliged to perform an operation in the course of the artery, we may give rise to serious mischief. At other times its direction changes, and from the middle of the fore-arm it curves to the external side of the radius. This, which is one of the most frequent varieties, ought particularly to be observed, as it might cause us to mistake the nature of the pulse, if, as often happens, a branch of some magnitude replaces the trunk. It might, also, give rise to serious hemorrhage, in a simple wound of the fore-arm. If the first results from the brachial dividing higher than ordinary, the latter arises from the small dorsal branch of the radial having acquired considerable size.

The ulnar, which, in descending, forms a slight and much elongated curve, with its convexity directed inwards, situated at first upon the superficial layer and the deep flexor, is in relation with the following organs: anteriorly and externally, the flexor sublimis; posteriorly, the flexor profundus; within the flexor carpi ulnaris, the tendon of which covers it more or less below. We see, on its radial side, its collateral vein or veins. The nerve touches it on its ulnar side. It is consequently very deeply seated superiorly, and very difficult to attain. It may, however, be exposed on a line drawn from the internal surface of the trochlea towards the external side of the pisiform bone. We seek for the intersection separating the anterior ulnar muscle from the common flexor, and which is always the first, coming from the posterior border of the ulnar.

The aponeurosis once divided on this line and the muscles separated, we find the nerve with its artery to the radial side, on the deep flexor muscle, at the bottom of the wound.

These relations only exist in the inferior four fifths of the fore-arm. Higher, the artery, obliquely downwards and outwards, separates more and more from the nerve.

Below, having cut through the skin, and divided the cellular

tissue, we must cut the first layer of the aponeurosis on the radial border of the flexor carpi ulnaris muscle. By pushing this tendon inwards, we find the vessel across a second fibrous layer, generally pretty strong, which keeps it applied on the internal portion of the deep flexor. Otherwise its relations are the same as in the rest of its extent.

Sometimes subcutaneous, so that its pulsations are visible beneath the skin, the artery, at other times, does not approach the nerve until quite at its inferior portion. There it would be difficult to tie it, particularly if, as I have four times seen, it were near the median line between the muscles, until quite low down. From the preceding, we perceive, that the ulnar artery is not capable of being firmly compressed, whilst the contrary is the case with the radial, in its inferior half.

The anterior *inter-osseous* divides at the point of union between the deep common flexor and flexor longus pollicis muscles. As it rests upon the anterior surface of the inter-osseous muscle, which it traverses above the pronator quadratus, it has been recommended to cut this ligament on either side, to allow of its being more easily secured after amputation.

The *superficial veins* communicate frequently with each other, and are excessively irregular, both as regards number and disposition. The largest and most constant are the ulnar, median, and anterior radial. The first, receiving most of the veins of the little finger, mounts along the ulnar side of the region, to constitute one of the roots of the basilic, over the internal muscular eminence, at the fold of the arm. It is sometimes sufficiently large to admit of blood being abstracted from it. The anterior branches of the internal cutaneous nerve wind round it. The second, commencing in the palm of the hand, follows the radial gutter, and gradually inclines towards the median line, as far as its entrance into the anterior region of the elbow, where we have already examined it. It is ordinarily the largest, and that from which blood may be obtained with greatest facility, when we cannot bleed in the usual situation. It must be recollected, however, that it is accompanied by a large branch of the musculo-cutaneous nerve, which is always to its radial side. The third, which proceeds from the ball of the thumb, does not usually enter the anti-brachial region until about its middle portion; the most irregular, and frequently absent, it is surrounded by very delicate filaments of the musculo-cutaneous nerve.

The *deep-seated veins*, disposed like the arteries, are very frequently double. The two radial, placed, one internal, the other external, anastomose from time to time with the ulnar and inter-osseous.

The *lymphatics*, very numerous, wind round the principal veins, and through the whole extent of cellulo-adipose tissue. The deep layer forms two remarkable groups around the radial

and ulnar vessels, and a third, less constant or less distinct, accompanying the inter-osseous. There are commonly no glands in the anterior region of the fore-arm. We, however, meet with one, sometimes two, and even three, in the course of the radial artery; always very small, but capable, from absorption, of morbid action, of acquiring a certain size, producing tumours, the character of which may easily be recognized.

The *nerves* are the same as at the bend of the arm. The *radial*, disposed like the artery, and lying to its external side, abandoning it below, to pass between the radius and tendon of the long supinator, runs no risk in the operation for aneurism, at the inferior fourth of the fore-arm; whilst, higher up, if we would avoid it, we must pass the ligature round the artery, from its radial towards its ulnar side.

The *ulnar* follows the direction indicated in speaking of the artery; but it only touches that vessel at about three inches below the internal condyle. More superiorly, it is separated from it by the internal muscular eminence. Near the wrist, the ulnar nerve sends its posterior branch behind the corpus, the anterior preserving the same relations to the vessel as the original trunk. As it could not be divided without the artery in a transverse wound, paralysis of the two internal fingers would be a sufficient indication of the extent of the mischief.

The *median* descends, particularly, between the two flexor muscles. The only branch which it furnishes below, is the palmar-cutaneous; however, this is not regular. The inter-osseous, also given by it, follows the artery of the same name, and always lies to its external side, sometimes so intimately that it is difficult to separate them. The other nervous filaments of the region are distributed to the muscles.

The *dorsal region* of the fore-arm, more regularly convex than the preceding, is at the same time more uneven. The principal objects remarked are, from within outwards, an elongated eminence, corresponding to the ulnar and extensor carpi ulnaris muscle; a fissure, indistinct above, much larger and more marked below; another eminence, formed by the fleshy portion of the extensor of the fingers; a second fissure, separating, superiorly, the latter eminence from that formed by the two radial extensors, and which winds above and in front of the extensor communis and extensor ossis metacarpi pollicis; finally, a third projection, corresponding to these latter muscles.

The *skin* presents numerous hairs, and encloses several sebaceous follicles. Uneven, wrinkled in thin subjects in some diseases, and when suddenly seized with cold, it is not very extensible.

The *subcutaneous tissue* does not adhere very firmly to the deep-seated parts.

The *aponeurosis* is confounded with that of the anterior

region, on the posterior border of the ulna. Opposite the external border of the extensor carpi ulnaris, it detaches a process, a kind of intersection, which becomes attached to the bone, forming a sheath for this muscle. It next, in the same manner, invests the tendon of the extensor minimi digiti, and, subsequently, gives a third sheath to the extensor communis. The extensor ossis metacarpi pollicis, the extensor primi and secundi internodii pollicis muscles, are equally enveloped by it, as they wind over the radius. Hence each of the dorsal muscles of the fore-arm is contained in a kind of fibrous canal below, whilst, superiorly, they are only divided by fibrous intersections, generally very solid. This arrangement is in perfect relation with their functions, as the fixed point is the same, or nearly so, for all, whilst the free extremity of one may act alone upon various occasions.

By fixing the aponeurosis at intervals to the bones, these septa endow it with much greater strength. The muscles, more regularly supported, thus acquire a degree of energy which they could not have possessed, had they been applied loosely upon the bone.

The *muscles* form two very distinct *layers*. The superficial comprehends the common extensor and the extensor minimi digiti, the extensor carpi ulnaris, and anconeus. The first is divided into two fasciculi; one in which we distinguish the origin of the tendons of the extensors of the index and little fingers, the other furnishing the middle and ring fingers; whence, the hand being closed, it is not possible completely to extend the ring finger without the middle, whilst the little and index fingers may easily be extended individually. The whole of its tendonous portion is enveloped in synovial membrane, favouring its action, and sometimes containing soft adipose vesicles, analogous to those found in the orbit. The second fasciculus, separating from the first at the upper part of the region, merits no particular notice, excepting that it is enclosed in a special sheath, allowing of its acting independently of the tendons of the common extensor. Thus, the little finger may be extended, although the other fingers remain flexed. The third, so placed below that its tendon is subcutaneous, is often divided in transverse wounds occurring on the inner border of the fore-arm. The fourth appears merely to be a prolongation of the triceps; its uses are of but little importance. As it were, bound down in a fibro-osseous sac, it may, in some positions, and in certain individuals, give the idea of swelling or abscess.

The deep layer encloses the extensor indicis, the extensors and long abductor of the thumb; the tendons of the radial are also partly contained. All these muscles, imbedded one upon the other, pass obliquely outwards and downwards, so that the tendon of the indicator is only isolated from those of the

common extensors at the wrist. It is the same with the long extensor of the thumb, which is situated a little more externally. The short extensor and long abductor, representing a spiral body, extending from the posterior surface of the interosseous ligament and radius to the ball of the thumb, are thus supinators of the thumb and hand at the same time that they are extensors and abductors. The aponeurosis supplies their tendons with a fibrous sheath, which is much stronger and firmer near the wrist. These tendons are there applied one on the other, that of the short extensor being posterior. They are sometimes separated by a thin septum, dividing their synovial membrane into two.

This membrane, or the organs which it encloses, may be the seat of a disease which I have frequently observed. A swelling, which is rarely very great, manifests itself in the course of these tendons, sometimes after considerable exertions; at others, without any apparent cause. This is accompanied with heat, and usually but slight pain, unless the patient moves his thumb. When we hold the swollen part with one hand, and move the thumb with the other, *we feel and hear a very evident crepitus;* so much so that I have heard surgeons pronounce it a fracture, and apply bandages accordingly. This disease, which I think that I described the first, in 1825, and which I have subsequently met with in nearly all the other fibro-synovial membranes, sometimes depends upon the gelatinous degeneracy of white swellings.

The tendons of the radial extensor slide between the preceding muscles and the posterior surface of the radius. They soon enter a fibrous sheath, weaker than the preceding, and in which they are separated by a septum, sometimes absent. The radial nerve winds round the bone between these latter tendons, the supinator, and the long abductor and short extensor muscles of the thumb.

The *inter-osseous arteries* are the only ones met with in this region. After giving off the ulnar recurrent, the posterior ramifies in the superficial muscular layer, and descends as far as the wrist. It is sufficiently large to require a ligature after amputation. The anterior, entering the dorsal region of the fore-arm at its lower fourth, remains close to the bones, and is rarely of a size to present any particular indication. Quite below, at from one to two inches above the head of the ulna, the posterior branch of the ulnar presents itself, very frequently equalling a crow's quill in calibre. I have already remarked in the preceding region, that the radial and ulnar arteries may also run behind the fore-arm by anomaly. They are always then very superficial, rendering wounds much more dangerous.

Veins.—The posterior ulnar and radial continuations of the cephalic, of the thumb, and of the salvatella form the two prin-

cipal. Phlebotomy is rarely performed upon them, not that the operation is dangerous, for they are surrounded but by very few nerves, but, rather, because the others are larger and more easily opened.

The *lymphatics* are few. Those of the superficial layer gradually wind over the sides of the ulna and radius, but especially over the latter, to enter the anterior region. The deep-seated mount with the blood vessels, and follow the same course.

Nerves.—The posterior branch of the radial nerve lies externally and above. Its branches proceed like those of the inter-osseous artery, which they everywhere accompany. The median and ulnar furnish the internal and superior portion, with numerous very delicate branches, which they give off near the elbow. Below, we find, lying immediately upon the bones, internally and externally, the posterior branches of the radial and ulnar, and, in the middle, at the bottom of the space, the posterior inter-osseous filament, given off by the median. Hence these branches may be painfully stretched, in fractures near the wrist. The internal and musculo-cutaneous ramify in the superficial cellular tissue, around the veins.

The *skeleton*, represented by the ulna, radius, and inter-osseous ligament, forms a double cavity, the deepest part corresponding to the middle of the fore-arm. It is entirely covered by muscles. The two bones are so placed, that the radius is largest inferiorly, whilst the ulna is most voluminous above; whence, united, they give the fore-arm the same transverse dimensions at every part. The former breaks more frequently superiorly than in its middle third, whilst the contrary occurs in the ulna, and in fracture of both, the solution of continuity rarely takes place in the same line. Slightly convex towards the skin, they are separated from each other by an inter-osseous space, about an inch wide in some individuals, and from four to five lines in others, gradually diminishing towards the extremities. As this space is closed by a fibrous membrane, towards which the bones become so thin, as merely to present a sharp edge, the anterior surface of the ulna, radius, and inter-osseous ligament, represents a kind of fossa, deeper and larger where these bones are most separated. The same thing, remarked at the posterior portion, makes the antero-posterior diameter naturally much less than the transverse. Thus, in fractures, we place graduated compresses and pads upon the extremities of the former, to prevent the bones from approximating. We must remark, that the displacement of the bones is not difficult to overcome, in fractures of the fore-arm; in fact, it requires that both ulna and radius be broken, for the bones to ride. When the fracture is not quite at the lower portion, this occurs with still more difficulty.

The muscles, being inserted at the same time upon both ends

of the bone, cannot produce this. It is true, that when the radius only is broken, its two portions are drawn towards the ulna superiorly, by the pronator teres, and below by the pronator quadratus, and the inter-osseous space may disappear; but still there will be no riding. When it is the ulna, we can merely have transverse displacement, and that of its inferior portion only, as the superior articulation does not admit of any lateral motion.

The *radius* only being able to roll over the ulna, at the expense of the inter-osseous space, we may comprehend that fractures consolidated in a wrong position would interrupt or entirely prevent pronation of the hand. In forced pronation, the radius, as it were, revolves over the ulna, and represents a lever, having its power below; whence the facility of luxation of the superior extremity backwards. Supination, on the contrary, by separating the bones, tends to luxate the head of the radius forwards. Thus, this accident may occur to very young children, from nurses lifting them from the ground by their hands.

Amputations in the fore-arm present different peculiarities, according to the point of the limb, in which they are performed. The skin being everywhere very mobile, it is always easy to raise it sufficiently without dissection; but the size of the parts to be covered, being less below than above, requires that we preserve most in the latter direction.

Near the wrist, we have merely the radial and ulnar arteries to tie. It is not necessary to pass the knife through the inter-osseous space, as we only meet with the tendons of the muscles. The soft parts are thin, and the skin alone remains applied over the extremities of the bones. In the middle portion, on the contrary, the radial, ulnar, anterior and posterior inter-osseous arteries all require tying. We must cut the muscles between the bones; the fleshy mass is considerable, but there are neither tendons nor synovial membrane.

SECTION FIFTH.

THE WRIST.

The wrist encloses all the articulations of the bones of the carpus, whether among themselves, with the fore-arm, or with the hand. It is about two inches long, and from two to two and a half transversely.

In *front* we feel through the skin, from without inwards, firstly, an eminence formed by the united tendons of the long abductor and short extensor of the thumb, which appears continuous, superiorly, with the anterior crest and styloid process of

the radius; secondly, a fossette, terminating the radial fissure of the fore-arm, by which we may penetrate into the joint; thirdly, below and internal to this fossette, a second eminence, corresponding to the scaphoid and trapezium bones, and which may be best seen when the hand is turned backwards. If the thumb and little finger touch, and the other fingers are extended at the same time that the wrist is flexed on the fore-arm, we perceive an extremely prominent cord, terminating on the preceding eminence. Formed by the tendon of the palmaris longus, in a state of repose, this cord and the bones mentioned enter into the middle eminence of the wrist, which is itself constituted by the whole of the flexor tendons, and by the flexor carpi radialis. Fourthly, a second fossette, terminating the cubital fissure of the fore-arm, and corresponding to the artery of the same name. Fifthly, the eminence represented by the pisiform bone, and the tendon of the flexor carpi ulnaris, and behind which is another fossette, surmounted by the head of the ulna. Sixthly, in the middle, and quite below, a superficial excavation, conducting into the palm of the hand.

The *skin* presents the same characters as in the palmar surface of the fore-arm. Among the lines remarked upon it, there are three which are nearly constant, and which may serve in operations. The first, on the superior limits of the region, at about half an inch above the styloid process of the radius, is sometimes wanting. The extremities of the second terminate at the summit of the ulnar and radial apophyses, and correspond to the radio-carpal articulation. The third, still more marked than the preceding, slightly convex below, separates the two eminences of the thumb and little finger, and the palm of the hand, from the wrist. In cutting upon it we come directly upon the articulation, between the two ranges of carpal bones.

The *subcutaneous layer* is never very thick; rather fibrous than cellular, it so connects the aponeurosis and annular ligament to the skin, that these two membranes are scarcely ever separated by serous infiltrations; and that, in fat individuals, we remark a kind of constriction at the wrist.

Aponeurosis.—Leaving the head of the ulna and pisiform bone, the aponeurosis splits to envelope the tendon of the flexor carpi ulnaris, and immediately gives a sheath to the ulnar artery. Its layers are collected in front of the flexor tendons, again separating to invest, at first, the tendon of the palmaris longus, subsequently, of the flexor carpi radialis, after which the radial artery, in its turn, receives a sheath. Lastly, it attaches itself on the anterior margin of the styloid process of the radius, and mingles with the fibrous sheath, in which the tendon of the extensor ossis metacarpi pollicis runs.

Inferiorly, its transverse fibres unite, are condensed, and appear to produce the *anterior annular ligament* of the carpus, in front of which the tendon of the palmaris longus muscle spreads itself

into an aponeurosis. This ligament, attached, on the one hand, to the pisiform and unciform bones, on the other, to the crest of the scaphoid and trapezius, splits, at the latter point, to form a sheath for the tendon of the flexor carpi radialis. Its inferior border is continuous with the palmar aponeurosis. The muscular fibres of the eminence of the thumb and little finger are inserted on the middle and sides; from this disposition the anterior ligament of the carpus forms the anterior half of a true elliptical ring, being about twenty lines in its transverse diameter, and merely an inch in the antero-posterior. Enclosing the tendons of the two common flexor muscles, extremely strong and inelastic, it resists tumours which have a tendency to become deep-seated, and forces them into the hand or fore-arm.

Muscles.—This region does not, properly speaking, enclose any; we only find some lines of the superior extremity of the muscles of the hand, and the most inferior fibres of the pronator-quadratus; but if we find no muscular fasciculi, we meet with a great number of tendons. Quite externally, is the termination of the long supinator, on the base of the styloid process, and the tendons passing to the thumb. These latter, enclosed in a very strong fibrous sac, produce the first eminence observed externally. They are sufficiently distant from the bones to allow the point of an instrument to pass between them from before backwards, penetrating by the fossette, which separates them from the second eminence, without opening the articulation. The tendon of the palmaris longus, at first on the median line, descends obliquely outwards to spread over the annular ligament, with which it unites. As it is only enveloped by the superficial layers of the aponeurosis, it is very evident through the skin, when it is drawn by the contraction of its muscle, at the same time that the thumb strongly opposes it. Externally, and rather more deeply, we distinguish the anterior radial, the fibres sheath of which is stronger and more complete than that of the preceding. As it approaches the second metacarpal bone, its tendon plunges into a strong canal, formed for it by the scaphoid and trapezium bones, on the one hand, and by the external extremity of the annular ligament on the other.

The *flexor carpi ulnaris*, equally isolated in the fibrous canal investing it, raises the skin in flexion and adduction of the wrist. In forced adduction of the little finger, it separates from the carpal bone, so that an instrument may be introduced between it and the articulation, without penetrating the latter. If the vulnerant body is directed obliquely, from before backwards, and inwards, or inversely, it would probably wound the artery and anterior branch of the nerve. Each of these tendons, having a peculiar sheath, is perfectly isolated from the surrounding parts, and may easily act, independently of the others. Those which enclose the carpal ring are not so situated. The flexor of the thumb alone appears separated from the others,

and draws with it a portion of the fibrous sheath enveloping the whole. They form a sort of packet, in which is also the median nerve. The membrane, at first uniting them *en masse*, and afterwards each one separately, lines the interior of the common canal.

Although thin and transparent when we hold it up to the light, this *layer*, nevertheless, offers much resistance. Its texture is evidently fibrous, yet possessing most of the characters proper to synovial membrane. Below the annular ligament, it seems to terminate in a cul-de-sac, the same as in ascending towards the fore-arm. Being of considerable extent, like all membranes of the same character, it inflames by exposure to the external air. Dangerous in itself, this inflammation becomes doubly so from the resistance offered by the aponeurosis to swelling of the parts, and particularly by the species of constriction exercised by the anterior ligament of the carpus. In consequence of this inflammation, wounds, and all deep-seated diseases of the wrist, are very serious. We there often find granules, similar to those described in the elbow, which seem to differ but little, excepting in size, from the foreign growths met with in large joints; they have been regarded as hydatids, but they appear to me to result from some albuminous or sanguineous effusion. The tumour enclosing them is almost always *double* or *sacculated*, that is to say, projecting at the same time at the palm of the hand and on the front of the wrist, in consequence of the anterior fibrous arch of the carpus. I have met with crepitation and gelatinous degeneracy of the radial synovial membrane.

Arteries.—The *radial*, placed on the front of the radius and pronator quadratus, winds backwards when it arrives in front of the styloid process, crossing the space separating the bones from the extensor tendons of the thumb, to enter the posterior region, and might be exposed in the radial fossette of the wrist. Before changing its direction, it furnishes a small branch to the ball of the thumb; subsequently, a second, which proceeds to the palmar groove, passing between the tendon of the radial muscle and the anterior annular ligament. The size of the latter is sometimes sufficiently large to give rise to considerable danger if wounded, and sufficiently superficial to be exposed and tied.

The *ulnar* continues to be covered by the tendon of the flexor carpi ulnaris and by two aponeurotic layers, as on the palmar surface of the fore-arm. It may be exposed and tied in the same manner. In some persons it is so superficial, that its pulsations may be felt in the ulnar gutter of the region. It inclines slightly as it descends to pass in front of the annular ligament and on the radial side of the pisiform bone. In the upper part of the region, that is, about an inch above the head of the ulna, a branch detaches itself, of variable size, proceed-

ing immediately to the dorsal surface of the wrist, crossing the nerve, always placed posteriorly. When this branch is large we may feel it on the inner border of the ulna. Here, also, an instrument, directed from this side, easily reaches it, and we might, without reflection, imagine that the ulnar itself were wounded.

The *superficial veins* form a plexus, habitually representing an arch, with the convexity turned towards the hand. These receive most of the branches of this part of the limb, and their extremities constitute the roots of the median and ulnar veins. The external branches, larger than the internal, may, if necessary, be opened for bleeding, but are rarely so, because there are always others of greater magnitude.

The *deep*, placed on the anterior surface or inner side of the arteries, are small, and merit but little attention.

The *lymphatics*, disposed as in the fore-arm, present no peculiarities.

Nerves.—Internally we see the continuation of the anterior branch of the ulnar lying immediately to the external surface, and a little behind the artery, and following its direction; externally, some branches of the radial; in the middle, the median, commonly equalling in size the tendons between which it lies. Before entering the carpal ring, the median nearly always gives off its palmar-cutaneous branch, which soon becomes superficial, and ramifies in the subcutaneous tissue, anastomosing with some filaments of the internal and musculo-cutaneous nerves. Posteriorly, as on the palmar surface, the wrist presents many objects for our notice: first, a fossette, bounded above and below by the root of the thumb and the extremity of the radius; in front, by the first eminence of the anterior region; and, posteriorly, by a kind of cord, represented by the long extensor. The radial artery crosses the bottom of this fossette, the depth of which is much more evident when the thumb is extended and separated from the hand. Secondly, the thumb being in the same position, and the indicator extended, whilst the other fingers are flexed, another excavation, shallower, but larger, limited, externally, by the tendon of the long extensor, and, internally, by that of the extensor indicis. This latter is, as it were, separated by the tendon of the long radial extensor into two triangular portions, one external, enclosing the head of the second metacarpal bone, and the termination of the radial artery, rather more externally; the other internal, having its base turned towards the radius, leads directly to the articulation. Thirdly, another fossette, corresponding to the interval between the extensor tendons of the ring and little finger. Fourthly, a small excavation, situated between this latter tendon and that of the extensor carpi ulnaris. This encloses the head of the ulna, which sometimes projects very considerably. Fifthly, the depression separating the two ulnar tendons, also the two internal

regions of the wrist. These different excavations, circumscribed by as many eminences, allow, on the one hand, pointed instruments to enter the articulation without dividing the tendons, and, on the other, synovial tumours, *nodes*, to project beneath the skin.

The *skin*, supple, although uneven, and lined, does not present any true wrinkles.

The *subcutaneous layer* preserves all the characters which it possessed in the fore-arm, and differs considerably, in that respect, from the same layer considered in the anterior region. Thus, all kinds of tumours may be developed here, as in the rest of the limb, and acquire considerable magnitude. This layer equally encloses superficial veins and some nerves, but little or no fat; at least near the posterior annular ligament, to which it adheres very strongly.

Between the styloid process of the radius and that of the ulna, the *aponeurosis* forms an arch, destined to bind down the tendons to which it furnishes different sheaths. This is the posterior annular ligament of the carpus, giving off, first, externally, a very strong sheath to the tendons of the extensor primi internodii, and extensor ossis metacarpi pollicis muscles; secondly, another sheath, descending perpendicularly, and enclosing the tendons of the two radial extensors; thirdly, the fibrous canal, enveloping the tendon of the extensor secundi internodii, and which is not complete until below the radius; fourthly, the posterior carpal ring, traversed by the tendons of the common extensor and indicator muscles; fifthly, an isolated sheath for the extensor of the little finger; sixthly, between the styloid process and the head of the ulna, another sheath for the tendon of the extensor carpi ulnaris. It gradually becomes thinner on the side of the fore-arm, and its inferior border is converted into a fibro-cellular layer, at first very thin, but thickening towards the hand.

The extensor tendons of the fingers and hand traverse the posterior region of the wrist. They are twelve in number; they have been, in some degree, described with the sheaths furnished to them by the aponeurosis. Those bounding the fossette of the first metacarpal bone, externally, have already been seen in the palmar surface.

The two radial separate as they descend, and are crossed by the extensor secundi internodii, which is itself placed between the fossette of the first metacarpal bone and that of the second. Those of the common extensor, four in number, and that of the index, are disposed in their ring, like the flexors in front; that is to say, they are enveloped by synovial membrane, permitting them to slide easily, together or separately. This membrane, however, appears less complex than that of the anterior region, and being surrounded by tissues of less density, its inflammations are neither so painful nor so dangerous. We do not here, as in the anterior, find the cartilaginous grains

already described, but it is often the seat of tumours known by the name of nodes or ganglions. These tumours may also depend upon a sort of hernia of the synovial membrane. In one case, as in the other, it would be dangerous to open them, from the inflammation which might result and rapidly spread over the fore-arm, hand, &c. In 1825, at the Hôpital de la Faculté, I saw a woman, who had borne one of these cysts for six years, in the course of the long extensor of the thumb. She wished to have it removed, and a young surgeon applied the treatment for hydrocele; intense fever supervened, abscesses formed in the sheaths, along the fore-arm, back of the hand, &c.

Arteries.—The *radial*, the only one meriting any attention, passing behind the root of the thumb, to arrive at the first inter-osseous space, is crossed by tendons of the primi internodii and extensor ossis metacarpi pollicis; afterwards, by the extensor secundi internodii. To expose it, in the excavation separating these tendons, we have only to divide the skin and rather a thick layer of cellular tissue. The *dorsal branch of the carpus* and the posterior branch of the ulnar are mostly too small to require any particular precautions in operations. The former, crossed by all the extensor tendons, traverses the region beneath the posterior annular ligament. The latter, already described in the preceding region, obliquely crosses the posterior surface of the ulna, covered by the tendon of the extensor carpi ulnaris and the extensor minimi digiti.

The *veins*, which may be traced across the skin, are, in general, very large. They most frequently assemble, internally and externally, to form two principal trunks; the internal, largest and most regular, bears the name of *salvatella;* the external, which merely receives the veins from the too first fingers, constitutes the *cephalic of the thumb.* They are continued along the back of the fore-arm, the former as the *ulnar*, and the latter as the *radial.* Phlebotomy was frequently performed upon them in former days; now they are rarely resorted to, unless those in the bend of the arm are unavailable. The deep veins offer no peculiarities.

The *lymphatics*, passing from the hand to the fore-arm, are disposed here as in those parts.

Some filaments from the cutaneous *nerves* of the brachial plexus terminate in the superficial layer of the back of the wrist. There, also, the posterior branch of the radial nerve divides into internal and external filaments, as does the posterior division of the ulnar. Their numerous branches ramify in the aponeurotic layer, crossing most of the tendons, so that they may be divided without wounding the latter; the consequence of which would be loss of the power of extension in the fingers.

The *skeleton* comprises the carpal, the heads of the metacarpal bones, and the extremities of those of the fore-arm. At first

sight, the metacarpal of the thumb and little finger alone appear capable of luxation forwards; but if, on the one hand, they have more mobility, and their ligaments are weaker, on the other the roots of the muscles, attached in front, maintain them in situ, and prevent displacement.

The bones of the carpus are covered by a fibrous layer, so dense that we have no example of their luxation forwards. Luxation of the radius itself is almost impossible, on one hand, from the strength of the radio-carpal ligaments, and, on the other, because the power, forcing the hand strongly backwards, at the same time applies all the flexor tendons firmly against the bones. The ulna is less strongly maintained on the carpus, but its relations with the radius are sufficiently firm to render its luxation rare and difficult. We have, however, met with this accident several times, and believe that it may be produced by forced supination. Then, in fact, if the humeral extremity of the radius cannot slip forwards, and if the force is sufficiently powerful, the head of the ulna will leave the cavity containing it below, and the hand remain in supination.

In examining all the bones covered by the ligaments we find—1. The anterior ulnar fissure, separating the styloid process from the head of the ulna; 2. A prominence formed by that head; 3. Another small fissure, corresponding to the radio-ulnar articulation; 4. A second eminence, presented by the inferior extremity of the radius, and terminating, externally, by a species of crest, forming the anterior border of the styloid process; 5. Below, a large semicircular fissure, the convexity directed upwards, and leading directly to the articulation of the fore-arm with the carpus; 6. Lower down, on the radial side, the projection, formed by the trapezium and navicular bones, the position of which should be well understood in amputation at the wrist, that the knife may slide in front without injuring it; 7. Within, and on the same line, the eminence of the pisiform and unciform bones—(this merits even more attention than the preceding in this operation, when we adopt the flap method; first, because it is more distinct; secondly, because it would be very easy to disarticulate the pisiform, and leave it in the flap;) 8. In the middle, a very deep transverse concavity, having for its base a portion of the anterior surface of the trapezium, scaphoid, cuneiform and unciform, trapezoid, semilunar, and magnum.

Posteriorly, the skeleton of the wrist presents, first, on the radius, various crests separating the tendinous sheaths, sometimes so prominent as to be mistaken for exostosis; secondly, the groove, traversed by the tendons of the common extensor, corresponding internally to the ulno-radial articulation; thirdly, the head of the ulna, projecting beneath the skin, between the tendon of the extensor of the little finger and that of the extensor carpi ulnaris. Inferiorly we meet a constricted portion,

representing the posterior surface of the bones of the carpus, uniting the hand to the fore-arm. Superiorly this species of *neck* offers a semilunar fissure, having its convexity upwards, which corresponds to the radio-carpal articulation. If the knife be introduced below when we amputate the wrist, it may enter between the two rows of carpal bones; above we should be likely to denude the radius and ulna.

The articulating surface of the bones of the fore-arm represent a very deep transverse concavity, and their processes are separated by a space of about two inches, whilst, from before backwards, the diameter of the radius is not more than an inch. Thus, internal or external luxation of the wrist is almost impossible. It can only occur after the numerous parts are torn. Posteriorly and anteriorly, on the contrary, the bony margin is but little marked, and the ligaments alone can oppose any resistance to the displacements which are favoured by the lateral motions of the hand. If the head of the ulna may, by chance, be luxated forwards during forced supination, it may also be thrown backwards during pronation, when the head of the radius is firmly fixed on the humerus. Lastly, the two bones may be separated by the same causes as those tending to produce lateral dislocation; this kind of *diastasis* is very frequent in fracture of the inferior extremity of the fore-arm.

Luxations of the wrist and fractures of the inferior portion of the radius have been, as yet, but imperfectly studied. Dupuytren, Goyrand, and Malgaigne maintain that the former are almost impossible, and that all the examples cited appertain rather to fractures. I am entirely of their opinion with regard to simple dislocation; but I have proved upon two occasions, on the dead body, a true luxation backwards, with rupture of the tendons and skin at the back of the wrist. In fact, if we fall on the hand when in a state of extreme flexion or extension, and the bones of the carpus present themselves to the radial articulating surfaces, almost perpendicularly, by one of their surfaces, we have their fracture to dread, and not simple luxation.

That which has deceived, and which will continue daily to do so, is the form which the limb assumes in such cases, that of an elongated *Z*; since the hand and inferior portion of the fore-arm are inclined forwards, whilst the carpus projects backwards. The slight crossing of the portions causes the head of the ulna to project, by drawing the hand towards the radial side. Hence, anormal tension of the external radial tendons, which, ceasing to be in contact with the bones, are separated from them like a cord. I had the opportunity of examining the parts twice in 1835. I found all the deformity completely explained by the displacement of the inferior portion outwards, subsequently, forwards or backwards, and that a very simple apparatus would suffice to keep the parts in apposition. The form of Z, and the raising of the radius, with the mobility and

crepitus which may or may not exist, positively indicating a fracture of the carpal extremity of the radius, proves that anatomy only, in reality, admits of torsion and fracture.

With regard to the carpal bones, they are too little exposed to external violence; their ligaments are too dense and numerous for them to be displaced one upon the other.

Less firmly imbedded, and possessing a rounded head, the magnum alone is capable of being forced from its situation. Thicker posteriorly than anteriorly, it is always displaced in the former direction, according to Chopart and Boyer. The first carpo-metacarpal articulation is almost the only one admitting of luxation. Isolated from the others, its surfaces are enveloped by a kind of capsule, sufficiently loose to accommodate itself to the motions of the thumb.

This accident can scarcely occur in front, in consequence of the mass of muscles of the ball of the thumb, or internally, in consequence of the facette of the os trapezium, which looks outwards and forwards, allowing great extent of adduction, without the surfaces separating, or directly outwards, because, in abduction the thumb is quickly arrested by the metacarpal bone of the index finger. Posteriorly and externally, on the contrary, the first metacarpal bone is only covered by skin, a weak layer of aponeurosis, and the fibrous capsule, which is also less resistant in this situation. Moreover, the articular facettes are smaller from before backwards than transversely, and the motion of opposition is that most frequently executed by the thumb; there are then only the extensor tendons to prevent its luxation.

The articulation of the fifth metacarpal bone with the unciform, although placed in a situation to admit of some motion, is not, however, sufficiently mobile to favour luxations; but it requires some examination on account of the operations performed upon it. Its surfaces are plane, and slightly oblique inwards. The three other articulations are almost immoveable. The posterior extremity of the second metacarpus is surmounted by two prominences, prolonged upwards for the attachment for the flexor carpi radialis and extensor carpi radialis longior; and the third presents a similar prolongation for the extensor carpi radialis brevior, rendering luxation very difficult.

SECTION SIXTH.

OF THE METACARPUS, OR HAND.

The hand, comprised between the inferior limits of the wrist and the root of the fingers, is irregularly quadrilateral. Like all the rest of the limb it presents an anterior or palmar region, and a posterior or dorsal.

The *palmar region*, more extensive than the dorsal, prolonged

for some lines backwards to the wrist, and on the articulation of the fingers in front, presents, first, externally the ball of the thumb, a muscular eminence, the apex of which terminates at the thumb; secondly, internally, a corresponding eminence, narrower, but longer, extending backwards to the pisiform bone; thirdly, anteriorly, when the four last fingers are approximated, three projections formed by the skin, and corresponding to the intervals between the digital roots; fourthly, in the same position, three fissures, separating the latter eminences; fifthly, in the centre, an excavation, extending from the index finger to the middle fissure of the wrist,—this is the *palm of the hand;* sixthly, in this cavity we remark several very regular lines. One, commencing at the anterior and external extremity of the palmar gutter, almost immediately bifurcates, the first of its branches describing a half circle round the ball of the thumb, and terminating behind the internal eminence. Another arises from the point where the former terminates, that is to say, at the wrist, and descends vertically on the middle of the preceding. The last extends from the interval separating the index from the middle finger to the base of the little finger, cutting the internal eminence into two unequal portions. Each of these three fissures appears to depend upon particular motions. Thus, the first is formed by the movement of opposition exercised by the thumb, and may be called the *line of the thumb.* The second occurs from the flexion of the other fingers, conjointly with flexion of the thumb, as when we would take hold of a cylindrical body, and may be termed the *line of the indicator.* The third appears to depend upon momentary extension of the index whilst the other fingers are flexed; this is the *line of the little finger.* Uniting the transverse portions of these two last, we have a fissure crossing the front of the hand, at about three lines behind the metacarpo-phalangeal articulation, which is the *metacarpal fissure.* These various depressions, which should be noted when incisions are required in the palm of the hand, are traversed or crossed by numerous secondary lines, which, however, are by no means regular.

The *skin,* generally very thick over the whole region, preserves a certain degree of elasticity on the ball of the thumb. Everywhere else it is thin and inextensible. It is never covered with hair, and sebaceous follicles have not as yet been discovered. The natural polish of the surface is replaced, among those who labour hard, by thickened horny substance, rendering inflammation more dangerous and painful. Besides the lines indicated above, we meet with a great number of others, depending upon the arrangement of the papillæ of the dermis over the ball of the thumb. These latter form curves, with the concavity directed towards the thumb, whilst, on the internal eminence, they form circles in its posterior half, and become almost transverse in front. Those of the palm of the hand diverge in front, receiving in their

separation the convexity of a small group of curved lines, which approach the roots of the fingers; bearing, however, no analogy to the skin in cicatrices.

Subcutaneous tissue.—Over the head of the metacarpal bone, and the internal eminence, this layer is composed of very dense filamentous cellular tissue, firmly uniting the deep tissues to the skin, and in which we find numerous adipose vesicles, incapable of acquiring any considerable size; but producing a kind of elastic cushion, varying but little in thickness, and prolonged over the fingers. Over the ball of the thumb, the cellular element, being lamellous rather than filamentous, the aponeurosis adheres less to the skin, and inflammations, abscesses, and tumours proceed much in the same manner as in any other part of the body; whilst, in the rest of the region, its dense texture gives rise to very serious mischief. In the palm of the hand there are no adipose vesicles, and, therefore, more elastic tissue.

The *aponeurosis*, very strong in the palmar excavation, becomes gradually thinner externally, and is merely a simple cellular layer over the ball of the thumb, where it is lost in the preceding.

Towards the internal edge of the hand, it gives origin to the palmaris brevis muscle, whilst, near the wrist, it is merely a continuation of the tendon of the palmaris longus, and of the anterior annular ligament. It divides into four diverging bands, which bifurcate to embrace the root of each finger, placed upon the flexor tendons, or, rather, becoming confounded with their sheath. It, also, gives off small semicircular processes, attached to the tendons, before they arrive at the first phalanx, and appearing, in this manner, insensibly to give origin to the proper digital sheaths.

The palmar aponeurosis presents a number of openings, produced by the fibres separating where they interlace. These openings, some very small, are largest and most numerous towards the fingers. They are filled with cellular tissue and adipose pellets; thus being the means of communication between the superficial and deep parts. They appear to concur in the production of the intense pain, occasioned by inflammation in the palm of the hand, from the constriction exercised by their margins upon the swollen parts.

Muscles.—Some appertain to the external, others to the internal eminence; the palm of the hand also contains its own. The *external mass* comprehends, first, the short abductor, more particularly covering the carpo-metacarpal articulation of the thumb, and strengthened by the tendon of the extensor ossis metacarpi pollicis; secondly, the short flexor and opponens, also preventing displacement in the same direction, and, internally, not from being applied upon the articulation, but, rather, by acting on the bone as a lever of the third class; thirdly, the adductor, a kind

of small fan, placed transversely, acting similarly as the two last, and preventing luxation, especially internally.

We meet, in the *internal eminence*, first, the palmaris brevis, extended beneath the superior fourth of the aponeurosis, which it fixes to the internal surface of the skin; and, on the ulnar side of the hand, this produces the small fossette which we remark within and beneath the pisiform bone, in the forced movement of opposition; secondly, the adductor minimi digiti, fixed to the pisiform bone, and appearing, as it were, attached to the tendon of the flexor carpi ulnaris; thirdly, the flexor brevis minimi digiti, often blended with the preceding, and, more deeply, the abductor, which is one of the palmar interossei. The third are the *lumbricales*, which can only be considered as dependencies of the tendons of the deep flexor muscle, favouring its action on the fingers, and inserted on the dorsal surface of the first phalanges.

The *flexor tendons* of the fingers also traverse this region, diverging towards the metacarpo-phalangeal articulation, where they enter their sheaths. That of the thumb slides between the two portions of the flexor brevis, before entering its investment. Beneath the aponeurosis, they are enveloped, collectively and individually, in synovial membrane, similar to that of the wrist, of which it merely appears to be a continuation. Hence, it may be the seat of the same diseases, produce the same and even greater danger, in consequence of the resistance opposed by the fibrous membrane to the swelling of the parts.

Arteries.—The ulnar and radial arteries terminate here, forming the superficial and deep *palmar arches*.

The *superficial* is placed between the aponeurosis and tendons. Its external extremity is continuous with the radial, across the commencement of the external eminence. Internally, it extends towards the ulnar, of which it is the continuation; we find it placed immediately on the radial side of the pisiform bone. A semicircular line, about fifteen lines in depth, having its two extremities fixed, the one on the crest of the scaphoid, the other on the pisiform, pretty correctly points out its course. Its ligature, however, is very difficult at the situation of injury, on account of the dense texture of the tissues.

The four digital arteries arise from its convexity, and pass, bifurcating at the base of the fingers, in the interval of the fibrous bands of the aponeurosis. It also gives off some large branches, ramifying in the internal and external eminences. The *deep arch* is less than the superficial; turned a little inwards and backwards, it is placed between the flexor tendons and the interosseous muscle. Its internal extremity comes from the ulnar artery, forming its deep branch. Separated from the trunk, this branch passes across the posterior extremity of the flexor brevis minimi digiti, to arrive behind the tendons. The other extremity of the deep arch proceeds between the adductor

and short flexor muscles of the thumb, in the posterior portion of the first interosseous space, where it communicates with the radial, to which it, in reality, belongs; and which furnishes two very large deep-seated branches to the muscles of the ball of the thumb, on the ulnar side of the first metacarpus, and the radial of the second. The convexity of the deep palmar arch gives four or five small branches, which follow the direction of the interosseous spaces, communicating near the head of the metacarpal bones with the dorsal branches. This arch furnishes, in addition, anteriorly and posteriorly, and by its concavity, others, anastomosing with the superficial, dorsal, &c. arteries, but which are generally very small.

The arteries of the hand communicate freely among themselves. The ulnar and radial form a very elongated curve, double, inferiorly, at its base, single at the fore-arm, where it is prolonged as far as the trunk of the brachial.

If one of the branches be opened, we can only arrest the hemorrhage with certainty by applying a ligature at each end, and when they are the seat of spontaneous aneurism, it is prudent to operate above and below the tumour. I saw a preparation, belonging to Beclard, in which all the arteries of the fore-arm and hand were much dilated. The palmar arches presented a very complicated plexus; all their branches, the size of a pen, were tortuous, undulating, similar to those of a large varicose patch, often observed on the saphena vein.

In a subject thus formed, the least injury in the palm of the hand would be succeeded by dangerous hemorrhage. In a preparation shown to me, by M. Lenoir, the superficial palmar arch was replaced by the artery usually accompanying the median nerve, and which was considerably dilated. Hence ligature, or compression, of the radial and ulnar would not have arrested the bleeding.

On the external eminence, the *subcutaneous veins* also preserve a certain volume, smaller on the ulnar eminence, still more so in the palm of the hand; they follow the distribution of the superficial arch, and pass into the anterior veins of the wrist, the deep accompanying all the branches of the corresponding arterial arch, and pass into the deep-seated radial and ulnar veins.

The superficial *lymphatics* form three or four trunks, most constantly met with in front of the muscles of the thumb, passing over the anterior surface of the wrist. The deep-seated accompany the artery, communicate with the superficial, and pass equally to the fore-arm.

Nerves.—Some superficial branches, furnished by the radial, are met with on the ball of the thumb, and the filaments of the small cutaneous palmar branch of the median ramify in the cellular tissue of the palm of the hand. The internal eminence receives the two terminating branches of the ulnar. These two cords separate opposite the pisiform bone, external to which

their common branch is situated, like its accompanying artery. The first runs to the two last fingers, over the muscles of the internal eminence, covered by the fatty cushion. The second dips across the posterior extremity of the opponens and flexor brevis minimi digiti, internal to the hook-like process of the unciform bone, to place itself upon the palmar arch, in front of the interosseous muscle, like the deep palmar arch; lastly, the median terminates in this region, giving origin to four or five large branches, diverging and bifurcating at the root of the four first fingers. All these branches, placed beneath the aponeurosis, run between it and the tendons of the superficial muscle, and, before arriving at the fingers, give a small filament to each lumbricalis.

The *dorsal region*, less complicated than the preceding, offers, externally, when the fingers are extended and separated, first, five cords converging towards the wrist, and derived from the stretching of the extensor tendons; secondly, three fossæ, situated between these tendons, and terminating by enlarging between the root of the fingers; thirdly, externally, when the thumb is in adduction, an eminence depending on the first dorsal interosseous muscle; fourthly, behind the muscular eminence, when the thumb is in abduction and opposition, the posterior extremity of the two first metacarpal bones, separated by a fissure several lines in breadth, at the bottom of which we find the radial artery, at the point where it enters the palmar region to form the deep arch; anteriorly, when the hand is closed, the eminences, produced by the heads of the metacarpal bones, the most prominent of which supports the median.

The *skin* differs but little from that of the corresponding regions of the wrist and fore-arm. Near the fore-arm, it is abundantly covered with hair, and contains numerous sebaceous follicles. Approaching the fingers, it becomes bare. The *subcutaneous tissue* is supple as on the wrist; it encloses superficial veins and nerves. The fibrous membrane of the back of the hand is thin and cellular, rather than truly aponeurotic. Its fibres are transverse, and appear to arise from the annular ligament. Passing to the fingers, it often contracts adhesions with the tendons, becomes more distinct, and is lost in front, in the cellular tissue. A second layer, of a similar nature, covering the posterior surface of the bones and interosseous muscles, mingles with the superficial, near the metacarpo-phalangeal articulation, with the ligament of the carpus above, and on the sides, also, with the palmar aponeurosis. Thus we find, between these two membranes, the tendons and principal nerves. In inflammations and suppurations, if the deep layer opposes the passage of the disease or its products into the palm of the hand, the superficial prevents them, for some time, from becoming visible, and circumscribed beneath the skin.

The *tendons*, seven in number, one for the thumb, two for the

indicator, two for the little finger, and the two others for the ring and middle finger, have not all the same form. That of the thumb is narrow and rounded. Those of the indicator, and that of the proper extensor of the little finger, are often formed of two bands, spreading over the metacarpo-pharangeal articulation, and blending with the tendon, which each of them receives from the common extensor. They all, reciprocally, send bands from their margins, and thus represent, with the tendons of the little finger, a *webbed-like* membrane on the back of the hand. This disposition partly explains the faculty of moving the fingers separately. If the indicator, the thumb, and the little finger are extended, and move very well, although the others remain in their original position, it is because each of them receives several tendons, of which one, at least, does not depend upon the common extensor. The motions of the middle and ring finger are, as we may say, checked by those of the middle and index fingers. The fourth finger cannot be extended when the third is flexed, because their tendons are too intimately connected. The synovial membrane, investing their anterior surface, does not form a particular bursa. Thinner and less distinct than that of the flexor tendon, it is more frequently the seat of *nodes* and *ganglia*.

The *muscles* are the four dorsal inter-ossei, among which we especially distinguish the first, in consequence of its size on the one hand, and, on the other, because the radial artery traverses it posteriorly.

Arteries.—The radial alone merits any attention; but as it merely arrives here, to plunge immediately into the most remote part of the first inter-osseous space, I do not think it necessary to enter into a long description of it. In consequence of its relation, it is almost always divided in extirpation of the first metacarpus, but may be avoided by keeping the knife close to that bone during the operation.

The other arteries at the back of the hand are furnished by the transverse metacarpal, which also give off the dorsal inter-osseous; and the anterior and posterior perforating. The posterior branch of the ulnar anastomoses with the metacarpal, and both are immediately applied on the deep fold of the aponeurosis. These branches are rarely of sufficient size to be of importance.

The *deep veins* follow the above-mentioned arteries. The others, or subcutaneous, are very large, and vary in number. Those of the two first fingers unite to form the *cephalic* of the thumb; those of the three last generally assemble internally, giving rise to the salvatella. They are enclosed in the superficial cellular tissue, and as this layer rarely acquires any size at the back of the hand, we sometimes bleed over the metacarpus, when there is difficulty, at the bend of the arm, which operation is more safe, as there are neither arteries nor nerves of

importance to preserve, and the tendons alone merit any attention.

There are but few *lymphatics*, and they soon wind over the border of the hand, to become continuous with those on the palmar surface. There are no glands known in this region, nor in the preceding and wrist.

Nerves.—Externally is the radial, with its one branch, ramifying on the thumb, and the other bifurcating to reach the indicator and medius. Internally, we find the posterior branch of the ulnar, disposed similarly to that of the radial, and proceeding to the two last fingers.

On the *palmar surface* the *skeleton* represents a sort of concave trellis. Its transverse concavity arises from the posterior extremity of the bones, being triangular, with the sharp edge directed forwards, and also from the concavity of the carpus itself. Its antero-posterior curvature is derived from its own bones, and depends upon the enlargement of their extremities, being only in front and on the sides; which causes the interosseous spaces to be larger in the middle than in front, and posteriorly. In the latter direction, the bones of the metacarpus are, as has been already stated, firmly fixed; but their heads, or anterior extremities, are only maintained by the transverse metacarpal ligament.

On the *dorsal surface*, this frame-work is convex, instead of concave. Its first bone being shorter, thicker, more mobile, and more covered by the muscles than all the others, can only be fractured with great difficulty; but it is frequently affected by caries, necrosis, and other diseases requiring its extirpation. The four last, being longer and less mobile, are often fractured, particularly by direct causes. Their fracture from indirect causes is rare, but not impossible. I saw a water-carrier, who had been pulled so violently by the index and median fingers, that the third metacarpal bone was broken.

All these bones may be amputated when their heads are disorganized, or for simple disease of the finger. We should then operate upon their dorsal surfaces, which are easily felt beneath the skin. As they are larger here than in front, we may, with more certainty, commence the two incisions at the same point, and reunite them on the anterior surface, having but a single division, and, by means of a chain saw, extirpate each of these, without traversing the palm of the hand. If we would disarticulate that supporting the index finger, we must recollect that its posterior extremity receives two tendons, and that its articular surface is slightly oblique outwards, which would oblige us to introduce the knife between the medius and second finger. This operation is equally simple for the thumb. It is always easy to distinguish the articulation of the fifth externally, by feeling, with the extremity of the finger, the posterior in-

ternal border of the bone we wish to remove. In fact, the first eminence met with is that resulting from the union of its posterior head with the unciform bone.

SECTION SEVENTH.

FINGERS.

Conical and delicate in women and children, cylindrical in most men, the fingers are far from being all the same length. The medius is the longest, the indicator and annular arrive to the same line, although the first is, in reality, the shortest. The little finger terminates at the origin of the last joint of the annular, and the thumb some lines behind the first phalangeal articulation of the indicator. The phalangeal articulation of the thumb is exactly on the same line as the metacarpo-phalangeal of the index finger.

On the *palmar surface*, the fingers present a number of fissures. There is only one in front of the last phalangeal articulation. Cutting perpendicularly upon it, we are about a line behind the articulation. There are many of them; but two in particular, in front of the middle articulation. Amongst these, the posterior is the most constant; it corresponds to the articulation, which is, at most, not more than half a line posterior. A fissure of the same kind is seen at the union of the fingers with the palmar surface of the hand, but not in the same relations with the articulations. The metacarpo-phalangeal articulation is eight to ten lines posterior. We must, however, except that of the thumb, in front of which we remark a fissure, disposed as at the middle joint. For the rest, we should fall directly upon the metacarpo-phalangeal articulation of the thumb, by prolonging a line on its base when in forced abduction, from before backwards, parallel to the direction of the indicator.

The *skin* is very thick; as yet no follicles have been recognized; but as variolous pustules on the other parts of the body most frequently occur in similar organs, and as the eruption in small pox is observed on the front of the fingers, I am inclined to believe that they really do exist. This membrane is covered by innumerable small lines, varying in direction, but generally in the form of elliptical circles on the pulp.

Subcutaneous tissue.—On the anterior surface of the body of each phalanx, this layer forms a very remarkable elastic cushion. Always thicker on the last phalanx, which it surpasses by some lines, in forming the pulp of the fingers, it is composed of fibro-cellular filaments, which appear to be detached from the skin to interlace frequently amongst themselves; thus forming an infinite number of small compartments. Its adipose vesicles

are delicate, never totally disappear, and are never sufficiently large to deform the fingers. When they are partly effaced in thin persons, the fingers flatten, and the joints appear more prominent. If, on the contrary, they distend, the fingers become round, and the dents of the articulations deeper. This layer owes its elasticity and slight extensibility to the mixture of cellulo-adipose vesicles with fibrous filaments.

The density of the tissue, the nerves, and the resistance to swelling, offered by the cutaneous layer, give rise to intense pain in acute inflammation. The elements swelling from disease, compressed, on the one hand, between two articulations, and, on the other, between the fibrous sheath and the skin, are, as it were, constricted, and the more so as the inflammation is intense. Thus, the best means of removing the pain caused by whitlow is to make a deep incision along the palmar surface of the inflamed finger.

The *tendonous sheaths* here replace the palmar aponeurosis, either by their longitudinal or transverse fibres. Completed by the anterior surface of the phalanges, they are of elliptic form, with the small diameter extended less over the articulation than in front of the phalanges. In consequence of their being thinner in front of the articulations, especially at the middle than in the interval, we not unfrequently find small separations, or communications between the interior and the preceding layer, in which portions of fat, occasionally synovial membrane, become implicated. The inflammations just described sometimes extend through these openings to the sheath, and pus, with subcutaneous inflammation, may reach the joints. When these sheaths have extended beyond the third articulation, their tissue becoming rarified, they mingle with the pulp and the periosteum. Having no communication with the articulations, their synovial surface buries itself in the fibro-cellular membrane, enveloping the flexor tendons, or forms a kind of cul-de-sac in front of the transverse metacarpal ligament, in this manner forming a small elongated pouch, having no opening, but up to a certain point endowed with functions, and liable to diseases, independent of those of other cavities of the same nature. We must remark, that in front of all the articulations, and especially those of the metacarpus with the phalanges, these sheaths are entirely fibrous, on account of the transverse ligaments, which form the posterior half, covering the whole of the articular surface.

In artisans, coachmen, and all persons whose work requires almost continual flexion of the fingers, the fibres of the palmar aponeurosis may, it is said, form bands in front of the tendinous sheaths, rendering extension of the phalanges impossible. Since this was remarked by Dupuytren, the retraction of the fingers generally attributed to shortening of the tendons, and looked upon as incurable by most practitioners, has commonly been removed with facility, as it is only necessary to cut the cord

in question across, in one or several points. It should be remembered, that the anormal band is not always formed by aponeurosis. In a patient upon whom I operated in 1833, it was evidently a fibrous transformation of the subcutaneous tissue, and I should not be surprized were it often so. I may now add to this remark, which has been completely substantiated by the researches of Goyrand and myself, that the proper palmar aponeurosis is not at all implicated in the disease. The ring, little, and middle fingers are most exposed to this singular affection, which appears to be confined to adults.

Each sheath encloses two *tendons*, excepting that of the thumb, which only receives one. They are so disposed, that the sublimis, at first lying upon the other, splits to give passage to the profundus. Its two processes, turned in, and approximating below, are attached in front, and on the sides of the second phalanx, mingling with the periosteum and fibrous sheath.

The profundus terminates at the last phalanx, but it detaches a more or less strong lamina, flattened transversely, which is fixed on the first phalanx; always, however, admitting of free motion. Called *falciform* by some anatomists, this explains the facility, preserved by persons in whom the two last phalanges have been amputated, of flexing the first, even when the extremities of the tendon are not fixed by inflammation in the flap raised over the extremity of the stump. Surgeons who have recommended amputation in the metacarpo-phalangeal articulation, when the disease admits of operating in the middle joint, have doubtless forgotten this anatomical fact. Otherwise, they never would have advanced, that the preserved phalanx would only be in the way, and must necessarily remain immoveable; and the same is probably the case with those who have proposed making a deep incision on its palmar surface, with the view of causing adhesion between the tendon and the surrounding parts, and, at a later period, to remove one or more of the phalanges.

The thumb has no flexor sublimis, and accordingly the motions of its first phalanx are more limited than in the other fingers. These tendons are white, smooth, and almost inert. When they remain for any time exposed to the air, they may slough, and transform into foreign bodies, as occurs when the interior of their sheath suppurates. At all events, they then become soldered to the other tissues, and the fingers remain immoveable.

Arteries.—Each finger presents two principal branches. When those from the superficial palmar arch arrive at the interval separating the head of the metacarpal bone, they bifurcate and pass immediately to the border of the two corresponding fingers. Each branch then lies on the side of the tendonous sheath, which it almost immediately touches, although enveloped in the sub-

cutaneous tissue. Anteriorly, these two arteries turn one towards the other, and anastomose, forming an arch in the digital pulp. In their course, they give several small branches to the cellulo-adipose layer, where they terminate. Although very large in comparison to the organs receiving them, we may, nevertheless, dispense with ligatures in amputation, because they are in general very easily compressed. Being always situated behind the collateral nerves, an instrument may divide the palmar surface of the finger transversely, as far as its tendinous sheath, without injuring them.

There are as many *veins* as arteries; some are very large, and may be called superficial, as they are placed in the subcutaneous tissue. Others, smaller and indistinct, follow the branches of the deep palmar arch.

The *lymphatics* are met with on each side of the finger, and accompany the blood vessels in general.

The *nerves*, distributed exactly like the collateral arteries, are furnished by the median and ulnar. The former supplies the thumb, index, and middle fingers. One of its branches, also, follows the radial border of the ring finger, at the extremity of which it anastomoses or unites with the ulnar, which, also, supplies the little finger. Extremely large, placed in front of the vessels, they may be wounded without the arteries being injured. This large supply of nervous filaments in the two first layers of the palmar surface of the fingers, in a great measure, accounts for the excruciating agony which has already been described.

The *dorsal region*, longer than the anterior, allowing that the palm of the hand extends over the posterior third of the first phalanx, presents, externally, when the fingers are extended, the termination of the three gutters mentioned in speaking of the metacarpus, which, in uniting the dorsal and palmar surfaces, form a thin and concave border, which we may name the *commissure* of the fingers. Between these grooves, we remark the eminences depending on the continuation of the extensor tendons.

In flexion it is always the anterior phalanx which glides upon the posterior; the head of the latter, in reality, alone projecting beneath the skin. The posterior digital surface presents several transverse wrinkles, indistinct over the body of the phalanges, but always well marked in the neighbourhood of the joints. We may almost constantly find three of these for each articulation, one in front, another behind, and a third in the middle. The latter is generally the deepest, and we should make the incision at two lines in front, when we would penetrate the joint. It must, however, be remarked, that this disposition does not hold good in the metacarpo-phalangeal articulation.

The *skin*, uneven, folded, supporting a group of hair on the bodies of the two first phalanges, more extensible, is much

thinner than on the palmar surface, and scarcely differs, excepting in its wrinkles, from that of the back of the hand. Arriving near the nail, it at first folds upon its root to the extent of from one to two lines, and thus forms a kind of sheath, which should be cut perpendicularly, by following the contour of the horny production, when we would remove the latter. The integuments next curve beneath this process, and thus become continuous towards its free border with the skin of the pulp. The skin is here very much more dense. The dermis adheres almost immediately to the bone, and it is, more particularly, the epidermis which envelopes the root of the nail.

Like those of M. Jardon, my researches prove, firstly, that the nail is formed of parallel fibres, and not of plates; secondly, that the epidermis terminates posteriorly, and on its margins, under the form of a band, adhering at one or two lines from its root; thirdly, that, behind this band, the nail terminates in a thin, dentated, and almost free border; fourthly, that, in front, we perceive a semicircle of greyish white, and, next, a rose-coloured tint; fifthly, that it adheres intimately to the dermis, by its deep surface, excepting posteriorly; sixthly, that, anteriorly, the epidermis terminates under its free border, by a kind of band, as it does on the dorsal surface. Hence, in inflammations termed whitlows, the nail falls off, and early incision is the best method of stopping the disease.

The *subcutaneous tissue*, quite different from that of the palmar surface, is merely a continuation of the cellular tissue of the back of the hand. Over the articulations, its processes unite, condense, and are frequently transformed into a kind of *bursa mucosa*. Approaching the nail, they become more dense, and blend with the skin. The veins and nerves ramify between them. Diseases pursue the same course as in the corresponding surface of the hand and fore-arm.

The *aponeurosis* scarcely exists, and is confounded with the tendons. These *tendons* form very complicated bands. Having passed behind the metacarpo-phalangeal articulation, their borders receive the tendons of the lumbricales and inter-osseous muscles, which may thus become flexors of the first phalanx. Behind the first phalangeal articulation, the extensor tendon spreads and separates into two processes, united by a thin membrane, and thus passes over the second phalanx. The two processes, then approximating, again separate to cover the last articulation, and terminate near the nail. Having no sheaths the membrane uniting their margins attaches them very solidly to the back of the fingers, so much so that they cannot, under any circumstances, slip to either one side or the other. Having no synovial membrane, they repose immediately upon those of the articulation, whilst over the body of the bone, very supple and extensible cellular tissue allows them to act with facility.

The *arteries*, furnished by the transverse metacarpal, the inter-

osseous branches of the deep palmar arch, and the collateral branches, are all very delicate, and almost capillary; wounds therefore, on the back of the finger are incapable of producing any alarming hemorrhage.

The *veins* are generally very large. On the back of the first phalanx, they, sometimes, form a kind of plexus, which may always be distinguished through the skin. They all empty themselves into the salvatella, or cephalic of the thumb.

The *lymphatics*.—The commencements of those of the back of the hand communicate with those of the palmar surface of the finger, and are of but little consequence in surgery.

Nerves.—The posterior branch of the ulnar supplies the ring and little finger, and, also, the ulnar side of the middle. The radial nerve gives branches to the thumb and index finger, and generally, also, sends a small branch to the middle finger; hence a wound of the ulnar side of the wrist might partly paralyse the three last fingers, whilst a similar wound on the radial side would only implicate the three first.

Skeleton.—The anterior surface of the phalanges being slightly concave, it is always easy to make a large and sufficiently thick flap in amputations. The union between the two first phalanges is, at the most receding fissure, rarely more than half a line, posterior or in front of the articulation. As for the posterior joint, we shall find it by following the direction of a line slightly curved, having its convexity anterior; the extremities falling behind the index and little fingers, about three lines in front of the transverse fissure of the hand.

Remarks.—The shortness of the phalanges and their great mobility render fractures difficult, excepting from direct causes. With regard to their luxation, although rare, they are, nevertheless, possible. They are less frequent at the metacarpo-phalangeal articulations in the three middle fingers than in the first and last. Anteriorly, this joint is solidly protected by the anterior ligament, flexor tendons, and their sheaths. The flattened tendons of the extensors are all we find posteriorly. Its lateral portions, maintained by two strong ligaments, are fortified by the tendons of the inter-osseus and lumbricales. On the other hand, the heads of the metacarpal bones are so much inclined towards their palmar surfaces, that the phalanges may turn over them to form right angles without the articulating surfaces losing their natural relations. On the contrary, as there are no ligaments, nor fibrous sheaths, but only slight tendons on the back of the fingers, and, as the articulating surfaces, in extraordinary extension, are all predisposed to dislocacation, luxation backwards occurs more frequently. Although this articulation is arthrodial, its lateral displacements are rare; on the one hand, because of the strength of the ligaments; on the other, because the motions of abduction and adduction are naturally very limited. Luxation of the little finger is

common in front, on account of the short adductor and flexor muscles inserted into the first phalanx. At the thumb it is still easier, by reason of the muscles, which are stronger and more numerous; but this advantageous disposition is counterbalanced by the presence of sesamoid bones, which considerably increase the extent of the articular surface of the first metacarpal bone. We must note, at the same time, that the supernumerary bones cause this articulation to come under the head of ginglymi. When once the displacement has occurred, the muscles generally present great opposition to its reduction. Boyer, who does not appear to have met with this accident, nevertheless thinks that it might easily be reduced, whilst he states that he had been baffled, as well as Chopart and Desault, in some dorsal luxations. I have twice seen the first phalanx of the thumb pass in front of the first metacarpal. In the first example, the luxation had occurred three days previously; there was no inflammation. I endeavoured to reduce it, but without success; MM. Bougon and Roux equally failed in their endeavours. The difficulties, still greater in luxation backwards, have been attentively studied by surgeons, and appear to depend on causes which anatomy fully explains at the present day. In fact, the head of the metacarpal bone, passing over the palmar surface of the phalanx, in some degree slits the short flexor muscle of the thumb, and becomes implicated in it, as in a button-hole; thus, the efforts for reduction are themselves obstacles to replacement. If the lateral ligaments are unbroken, they assume a perpendicular direction, and thus prevent the approximation of the surfaces, because the extremity of the phalanx then represents a wedge entering between them, by its base. This obstacle, noticed by Hey, still more manifest in the anterior luxation, in consequence of the dimensions of the metacarpus in front, led M. Evans to remove the two extremities of the bones, and Bell to divide the lateral ligaments of the articulation, by means of a cataract needle. But the researches of M. Pellot have demonstrated, that the anterior ligament is the principal difficulty. Solidly united to the phalanx, it separates from the metacarpal bone. When once drawn with the fibres of the short flexor, which are attached to the back of the bone, all efforts to draw the phalanx forwards tend to place it between the articular surface, and the luxation is immediately re-produced. M. Pailloux ascertained, that, instead of extending the thumb, we ought to turn it backwards, so as to force the free border, or ruptured ligament, to the front of the metacarpal cartilage, and not to lower the phalanx until later. The reduction must always be difficult. M. Duges relates two cases where he met with no obstacle, and I was equally fortunate in two others.

The fibrous elements, surrounding the phalangeal articulations, are similar to those we have seen in the preceding; but the articulating surfaces differ, inasmuch as they form a perfect

ginglymus. Lateral luxations are, consequently, still more difficult. In front they meet with the same obstacles. The condyles of the first phalanx project as strongly in this direction, as the head of the metacarpal bone, and flexion of the fingers may be carried still further. It is, therefore, backwards that luxation may especially occur. The contrary kind is most frequent in the thumb. Some persons have the power of producing and reducing it at will. Although, generally, less embarrassing than at the metacarpo-phalangeal articulation, luxations of these joints are sometimes extremely difficult, particularly in the thumb. I have seen three cases where reduction had been unsuccessfully attempted, by three different surgeons.

Relative to amputations, the convexity of the phalanges, in most cases, prevents the formation of a sufficiently large or thick dorsal flap, even where the substance of the soft parts would allow it. It, on the other hand, renders extirpation of the first or second phalanx easy, without the removal of the other. This, in extirpation of the thumb, where the smallest portion of the skeleton is of importance, is a resource of which we should always avail ourselves, especially as it would not be more difficult than at the first metacarpus.

The metacarpo-phalangeal articulation being of a different class, the steps of the operation are not the same as when we amputate the first phalanx. After semilunar incision, the convexity of which corresponds to the middle of the commissure of the fingers, the first eminence met with is the head of the phalanx. The articulation, always exposed with facility, is situated some lines beyond. The relief, formed externally by the heads of the metacarpal bones, points out the place which it occupies, and, should the swelling prevent its being seen, we must remember, that the articulation is always eight or ten lines behind the digital commissure.

Remarks.—The tissues are so disposed around the phalanges, that inflammations of the dorsal surface proceed as on the corresponding region of the wrist, whilst, in front, they offer peculiar characters. Beneath the epidermis, retained by the articular fissures, they here follow nearly the same course over the three phalanges, that is to say, they cause considerable pain, and burrow very far beneath the epidermis, without any manifest swelling resulting in the deep-seated layers. Beneath the skin, they are equally retained, between the articulations, by the adhesion of the dermis to the anterior ligaments; but they extend towards the dorsal surface, under the form of erysipelatous swelling, in consequence of the suppleness of the skin and subcutaneous tissue in this situation. Besides causing the dermis to ulcerate, from the interior to the exterior, the pus, meeting with a thick and hard epidermis, spreads beneath it, producing a whitlow, much larger where the ulceration is situated beneath. Nothing arresting them, those of the fibro-synovial sheath are

distinguished from the others by their rapid extension to the side of the hand. However deep they are in the pulp of the fingers, inflammations rarely lead to these results, because the tendinous sheaths are not prolonged so far. Thus, disarticulation of the last phalanx, all things considered, is infinitely less dangerous than that of the second or first.

CHAPTER THIRTEENTH.

OF THE INFERIOR EXTREMITIES.

Supporting the weight of the body, very distant from the heart, the inferior extremities are on that account more exposed than the superior to infiltrations and swellings, whether lymphatic or sanguineous, and to all diseases resulting from stagnation of the fluids. Thus, they are almost the exclusive seat of elephantiasis, varices, all kinds of ulcers, and chronic swellings, depending upon interruption of the circulation. Receiving their vessels from the pelvis, they participate in the greater part of the chronic affections and changes manifested in that cavity: the developement of the uterus, during pregnancy, any tumour in the pelvic excavation, or iliac fossa, daily proves this. Their distance from the heart causes the blood to reach their ultimate arterial ramification with difficulty, and is the reason why they are almost constantly the seat of gangrene in old age. Pressed between the sole and the trunk, they may deviate, bend in various directions, and undergo all the species of deformities, produceable by mechanical agents. Their length and uses in locomotion, or station, alike favour fractures, &c.

Their form, more conical than cylindrical, their muscular, bony, or tendinous eminences, prevent equal pressure. The hair covering their surface, generally very abundant and long, forbids, even more than in the arm, the application of any plaster or operation, without previously shaving the part. Joined to the follicles, which are near the root and to the substance of the skin, these hairs explain, to a certain extent, the prevalence of erysipelatous, herpetic, and pustulary affections. Their subcutaneous tissue, forming everywhere an equal and supple layer, renders diffuse phlegmon as easy as serious, and gives a mobility to the integuments, which is extremely favourable to the closing of wounds, after operations, &c.

Here, particularly, the aponeuroses present themselves with all their sheaths. The general investment which they at first form for the whole limb, much thicker than in the upper extremities,

explains why superficial inflammations more rarely become deep-seated. The secondary sheaths, almost as numerous as the muscles, and generally very manifest, present all the peculiarities common to aponeuroses in general. Entirely confined to progression and station, the lower extremities are replaced, artificially, with less difficulty than the superior. The size and length of their principal arteries account for the aneurisms met with, and the danger attending wounds in its direction. Their variable dimensions cause the difference of height in various individuals. Like the upper extremities, they are naturally divided into six portions: first, the haunch, corresponding to the shoulder; secondly, the thigh; thirdly, the knee; fourthly, the leg; fifthly, the tibio-tarsal articulation; and, sixthly, the foot.

SECTION FIRST.

INGUINAL REGION.

The groin is the only region to be examined in the first division of the pelvic limb. Its limits are not so determined that all anatomists agree upon them; some comprehend, under this title, the simple fissure separating the anterior portions of the abdomen and thigh. Others add the iliac region; others, again, give this name to the triangular space circumscribed by Poupart's ligament, and the adductor longus and sartorius muscles. I should adopt this latter idea, were it not then necessary to make another region for the organs surrounding the thyroid foramen.

By the inguinal region, I comprehend all the soft parts hiding the root of the limb in front, and that portion of the skeleton supporting them.

Externally, in a thin and muscular man, we find, first, superiorly, Poupart's ligament as the superior limit; secondly, below, a fissure, proceeding from the anterior iliac tubercle, beneath the ischium, to join the sub-ischiatic or gluteal fissure. Crural herniæ manifest themselves in this *fold*. Depending upon the motions of the thigh on the abdomen, its depth is considerably increased in flexion of the limb; thirdly, externally, a vertical eminence, indicating the position of the *tensor vaginæ femoris muscle;* fourthly, a second eminence, obliquely inwards, caused by the sartorius muscles; fifthly, between these two projections, a triangular depression, with its base below; sixthly, within, a third eminence, more marked than the preceding, obliquely outwards, and corresponding to the rectus and adductor longus muscles; seventhly, between the latter and the sartorius, a triangular excavation, with its base above, constituting the *proper inguinal cavity*, and allowing the pulsation of the artery to be

felt beneath the skin. We may say, without forced analogy, that the inguinal excavation, and muscular projections circumscribing it, represent, pretty nearly, the axilla.

The *skin*, thick and dense on the external eminences, is very thin and loose in the groin. The hair of the pubes advances a little upon it, and numerous sebaceous follicles are met with in its substance. We may say that these follicles, sometimes giving off a very fœtid secretion, appear imbedded in the most superficial layers of the subcutaneous tissue. In the bend of the groin, we should divide the skin parallel to its direction, if we would avoid irregular cicatrices.

The general *subcutaneous tissue* presents here, as elsewhere, two distinct lamellæ. That nearest the skin encloses adipose cellules; the other, deeper, has a very distinct membranous appearance. They form two planes, as in the abdomen. One continuous with the general subcutaneous fascia; the other, appearing to fix near Poupart's ligament on the pubes, after interlacing with the similar layer of the iliac region. Containing the saphena vein, and the branches running to it, the latter, also, encloses the superficial glands of the groin. Its union to the crural arch and below, causes herniæ to be compressed during extension of the thigh, rendering it necessary to flex the limb, when we apply the taxis. Inguinal tumours, from this cause, may mount beneath the integuments of the abdomen, as may, also, infiltrations, abscesses, &c.

Aponeurosis.—Since the time of Hesselbach, the fibrous layers of the groin have been the objects of considerable labour and research, by Sir A. Cooper, Hey, Colles, Scarpa, J. Cloquet, A. Thomson, Verpillat, Lebaudy, &c.

My description, however, differs from theirs in some respects. Examined externally, this aponeurosis passes over the rectus femoris, internal to which a strong layer, coming from the pelvis, is detached, to slide between it and the psoas and iliacus. Subsequently uniting, posteriorly, to the capsule of the joint, it immediately splits to envelope the sartorius. Internal to this muscle, it adheres superiorly to the inferior border of Poupart's ligament, to split again shortly. Of the two lamellæ resulting, the deep sends a thick process between the psoas and pectineus muscles, before arriving beneath the vessels, and investing the anterior surface of the adductors, and, subsequently, the pubic crest, as far as the bottom of the inguinal region. Internally and superiorly it terminates, by coming in contact with Poupart's and Gimbernat's ligaments. The superficial layer, which we have left near the sartorius, separates from the preceding, passes in front of the crural vessels, and concurs by fixing itself, by its apex, on the crest and close to the spine of the pubes, in the formation of Gimbernat's ligament. It is triangular or falciform; one of its edges, the superior, is attached to Poupart's ligament; another, the external, is its commencement. The third repre-

sents a kind of arch, and circumscribes the superior and external portion of the crural opening.

The *crural canal.*—The *inguinal opening* of the crural canal, at its internal and inferior portion, more resembles a gutter of oval form, its larger extremity outwards and downwards, and its apex at the external pillar of the ring of the external oblique.

This opening curves in a semicircle, from the side of the pubes, outwards and downwards, immediately extending from without, inwards and upwards, as if its termination would glide under its point of origin, making a spiral turn; its axis falling obliquely, from within outwards, on the antero-posterior axis of the thigh. Being filled or closed by lamellæ, a kind of rarification of the *fascia lata*, many persons have considered that it does not in reality exist; but, taking the saphena for a guide, we shall always find it, provided we remove the reticulated, cribriform membrane concealing it.

The *posterior wall* of the crural canal is formed by the deep layer of the *fascia lata*. Its *external side* is two inches and a half long, oblique from above downwards, and inwards, and formed by the separation of the two layers of the *fascia lata*. Its *internal side* only extends from the pectineal crest, or Gimbernat's ligament, to beneath Poupart's ligament. The opening in the superficial layer of the aponeurosis replaces it in this direction. Its inferior orifice, leaving a portion of the vein visible, encloses deep lymphatic glands and cellular tissue, uniting the subcutaneous to the sub-peritoneal *fascia*.

This canal, a true continuation of the iliac fossa, divested of viscera, peritoneum, and of the fascia propria filling it, enters beneath the internal portion of the femoral arch, and proceeds to the thigh, forming a duct, the anterior wall of which is wanting, where it receives the saphena vein, and which terminates by becoming continuous with the sheath of the sartorius muscle.

Hence, we may easily understand, how matter, effused in the abdomen, between the peritoneum and aponeurosis, may be transported to the groin, producing infiltration of the limb, or giving rise to abscesses by congestion, likely to be mistaken for herniæ or other tumours. The matter, also, instead of accumulating beneath the skin, may continue to descend, following the sheath of the sartorius to the bottom of the thigh.

The space existing between the superior iliac spine and that of the pubes being larger in woman than man, femoral hernia is more frequent in the former than the latter, which is further augmented by another anatomical reason; namely, because the inguinal, very narrow in females, has no scrotum prolonging it to the exterior. The viscera cannot escape there, as in man, but extending, on the contrary, into the crural fossette of the region, they escape more easily through the femoral canal.

Nevertheless, the pelvis, in childhood, differs so little in size

in both sexes, that inguinal and crural herniæ are as common in one as the other, up to the age of ten. It is only after puberty that the difference is observable.

Entering the crural canal, the viscera descend almost perpendicularly; but their exit being from behind forwards, and inwards, it is necessary to compress them from before backwards, following the axis of the aponeurotic opening, in order to push them, subsequently, upwards. When they mount into the bend of the groin, between the superficial fold of *fascia lata* and subcutaneous fascia, instead of continuing their descent, the hernial sac, with the part which it encloses, curves at a more or less acute angle. Therefore, if pressure be exercised in the same manner, the tumour, far from re-entering, will flatten, and to reduce it we must push it from above downwards, and from without inwards, until we have brought it opposite the external opening of the canal. The walls of the canal being all aponeurotic, and, consequently, but slightly extensible, the viscera form a globular, hard tumour, strongly sustained by the fascia lata, posteriorly, and the fascia superficialis in front.

The portion of the *latter fascia*, closing the crural opening by means of various bands, sometimes divides the tumour into distinct lobules.

The frequency of constriction in crural herniæ arises from the dense structure of the tissues, traversed or separated by the organs, and also from the acute angle which these latter are obliged to make in escaping. This constriction may occur at the femoral opening of the canal, at its abdominal ring, or at the neck of the sac. If, as I consider, the first is the most common, it will be quite sufficient to cut upwards and outwards, on some point of the concave border of the falciform process of the aponeurosis, to relieve it, without entering the abdomen. The incision of the external ring almost always allows of the reduction of the parts, not only when it is itself the cause of constriction, but also when that occurs much higher up. This arises from the semilunar border of Gimbernat's ligament, instead of being sharp and finishing abruptly, inclining downwards towards the thigh, becoming uninterruptedly continuous with the two portions of *fascia lata*, forming a gutter, which constitutes the internal third of the canal. Hence, an incision, upwards and outwards, suffices in the majority of instances. My experience has led me to consider, that this method renders the operation much less dangerous.

When the constriction occurs at the upper ring, it is rarely caused but by the semilunar border of Gimbernat's ligament, unless it be produced by the inferior border of the crural arch itself. Pott remarks that the depth of the parts would then render the incision delicate and very dangerous, especially in man. In some directions we can scarcely avoid injuring some important organ. If upwards and outwards, as recommended

by Sharp and Dupuytren, the instrument is directed immediately towards the epigastric artery; directly upwards, as was practised before the time of Arnaud, or rather upwards and inwards, towards the umbilicus, as advised by Heister and Desault, when the tumour is near the pubes, we run the risk of dividing the pubic branch of the epigastric artery in both sexes, and in man the spermatic artery and vas deferens. Founded on the facts reported by Arnaud, and experiments at the Hôtel Dieu, Scarpa considered that we could not cut more than two lines into the inferior border of Poupart's ligament, without injuring the spermatic vessels; but these fears are evidently exaggerated. Upon most dead bodies we may cut from three to four lines without touching the cord, and the softness of that organ allows it to yield and roll away from the knife, in some degree preventing its division; besides which, it may be drawn inwards and upwards, out of the way. Let us observe, however, that in following this direction, if the epigastric artery be within, we should almost inevitably divide it, inasmuch as, being drawn towards the median line by the displaced parts, its curvature would thus be considerably augmented. The neck of the sac being embraced internally by the margin of Gimbernat's ligament, we should naturally cut in that direction. Mauchart, in 1748, recommended the incision to be made parallel to the direction of the horizontal portion of the pubes, but only to avoid the epigastric artery. Richter advised the same, and Hey practised it. But Gimbernat is the first who pointed out, that, by cutting along the body of the pubes, we might divide the triangular fold of Poupart's ligament, to the extent of four, five, or six lines, without endangering either cord or artery. However, the pubic branch of the epigastric would most frequently be wounded if we were obliged to prolong the incision beyond the above extent. By cutting obliquely downwards, separating, as it were, Gimbernat's ligament from the external pillar of the inguinal ring, we almost constantly avoid it.

This method, recently modified by Verpillat, who advises the incision to be carried directly backwards upon the pelvic process, has nothing against it, further than the inability of always reaching the most constricted portion of the ring; but this inconvenience is very slight, as we can generally cut to five lines; and, moreover, in crural herniæ, better than in inguinal, it is just possible to divide in all directions, and to adopt the multiplied incisions of Vidal. In the female, unless from anomaly, at least, when the epigastric artery does not run horizontally to the rectus muscle, in the direction of the crural arch, as M. Verpillat relates, in cutting upwards, the small transverse artery of the pubes is the only organ of importance which can be wounded, the inguinal ring only containing the round ligament, in place of the spermatic cord.

In exposing the viscera we must not expect to meet with the same tissues as in inguinal hernia. Placed, from any cause, in the lesser iliac or crural fossette, they push before them the peritoneum, which, in its turn, becomes enclosed in fascia propria. This latter, derived from the cellular tissue filling the canal, is thicker in the centre than where the intestine enters. The fibro-cellular tissue, covering the external opening, next unites to the fascia propria, unless the hernia escapes through one of the openings by which this membrane is perforated. Up to this point the parts have proceeded parallel to the axis of the body, but now they follow the direction of the axis of the external crural ring, leaving the femoral vessels and saphena vein external. The superficial fascia is then applied upon the preceding double envelope, and the integuments cover the whole, in addition to the glands, which also surround the hernia, and which we will describe hereafter.

In a preparation shown to me by M. Langier, Gimbernat's ligament, larger and stronger externally than usual, was so thin and weak near the pubes that the hernia had traversed it, instead of passing through the crural ring. The incision in this case should be made on the fibrous circle, as on the ring of the external oblique, and not on the falciform border of the aponeurosis. The saphena, always pushed backwards and downwards, need cause no apprehension. However, by making a crucial incision, like Dupuytren, it might possibly be wounded in terminating the vertical incision. Thus, instead of six investing membranes, as in scrotal hernia, we have here, in reality, but four; the skin, subcutaneous fascia, subperitoneal fascia, and the sac; and neither fascia of the cord, cremaster, nor fibrous membrane of the ring. The peritoneum sending no prolongation beneath the crural arch in the natural condition, this species of hernia cannot be congenital.

The groin contains numerous *muscles*. The sartorius having a complete sheath, pus formed in it would spread in its fibrous canal, and might extend to the bottom of the thigh without flowing into the surrounding tissues. Its weakness here favours its rupture in violent exertion; such, for instance, as preventing the pelvis falling backwards, when the feet suddenly slip forwards.

The *gracilis*, or *rectus internus*, oblique from within outwards, is provided, like the preceding, with an aponeurotic sheath, which presents more resistance to pus, &c. anteriorly than posteriorly.

The *adductors* are so disposed, that the first, or *longus*, attached, external, to the gracilis, a little above the subpubic foramen, proceeds, spreading towards the posterior border of the femur. The second, or *brevis*, also attached to the pubes, but beneath the preceding, equally internal to the obturator foramen, is at first concealed by the pectineus, and terminates on the same

plane as the other two, before it is inserted beneath the lesser trochanter. The third, or *magnus*, arising from the whole of the external lip of the ischium, and also the commencement of its ramus, passes behind the two former to be inserted into the linea aspera and border of the great trochanter. Its fibres diverge as they leave the ischium, so that the superior are transverse, whilst those succeeding become more and more oblique as they descend. Between the quadratus and the third adductor, there is a *cellular space*, conducting from the gluteal into the inguinal region, where pus, arriving from the ischiatic notch, may consequently form abscess by congestion.

The *pectineus*, almost entirely in the region of the groin, forms the plane of the crural canal. Arising from the crest of the pubes, covered by the deep process of the *fascia lata*, it constitutes, posteriorly, the anterior wall of the sub-obturator cellular excavation; consequently hiding the anterior portion of the external obturator, the vessels and nerves which leave the pelvis by the thyroid canal, as well as the viscera, when they escape through this opening.

The *obturator externus*, the deepest of the muscles of the groin, filling all the obturator fossa, is attached to the thyroid membrane, and crosses the sub-cotyloid fissure of the ischium to be inserted in the digital fossa of the femur. Turning the foot outwards, it continually tends to approximate the trochanter to the ischium, in fractures of the neck of the femur. It lies on the adductor magnus, covered by the pectineus. The vessels and nerves pass over its anterior border, and thyroid herniæ form in front.

We found the commencement of the subpubic canal in the pelvic cavity; we here find its external opening. It differs from the internal in having the upper border of the muscle unenveloped by aponeurotic expansion, or fibrous membrane, and, therefore, easily depressed.

The intestine, entering here, penetrates very easily into the sub-obturator excavation. The neck of the sac is surrounded by the subpubian gutter in front, and, externally, by the border of the obturator muscles, and the arch of the thyroid membrane below, and internally. In the latter situation we meet with the vessels; at least, such was their position in the subject examined by Sir A. Cooper. However, they may also be found externally, and even in front, although more rarely, as they partly traverse the external obturator muscle. On leaving the canal, which is oblique from behind forwards and inwards, the organs are enveloped, first, by the peritoneal sac; secondly, by the cellular tissue of the sub-obturator excavation, spread over the *fascia propria*, with which it blends; thirdly, anteriorly, by the adductor brevis and pectineus muscles; fourthly, internally, by the adductor longus and gracilis, and, posteriorly, by the adductor magnus. Their deep situation most commonly prevents their projecting outwards, or, rather, their swelling is so deep-seated,

that they may easily be mistaken for abscess. Subjects have been met with in whom the thyroid hernia was sufficiently large to produce a considerable eminence in the groin. Such was the first fact mentioned by Garengeot, and that by Dupuytren. However this may be, it is rarely constricted, which is more astonishing, as the posterior opening is not at all extensible, and the more fortunate, as the operation would be extremely difficult and dangerous, and, according to Malaval, has only been performed by Armand.

The *rectus femoris* presents nothing remarkable here. We must, however, observe, that, by means of its reflected tendon it unites the aponeurosis of the thigh to the capsule of the hip joint. Identified, as it were, with this capsule, it becomes a principal agent in opposing luxation of the head of the femur, upwards and outwards. It is analogous to the long portion of the triceps, beneath the glenoid cavity. The *triceps*, enveloping the femur from the base of its neck and great trochanter, presents no surgical interest in the groin. The *psoas* and *iliacus*, united, on the contrary, require particular attention, from their relations to the aponeurosis, crural arch, and articulation.

The *iliac canal.*—The sheath enclosing the two extremities, being a continuation of the iliac fossa, occasions the variation of depth in abscesses from congestion, in the upper part of the thigh, in different individuals. When the matter has been transported to the groin, through the intervention of the *fascia propria*, across the crural canal, the abscess will be subcutaneous; whilst, when it infiltrates beneath the iliac fascia, it remains under the deep portion of the aponeurosis. Gradually distending this layer, it pushes the vessels forwards and inwards, forms a more or less marked projection at the anterior and internal portion of the thigh, and generally leaves the fold of the groin free. Piercing the septum, prolonging the iliac and psoas muscles from the pectineus, or that which is placed between the first of these muscles and the rectus femoris, pus may equally extend into the sub-thyroid excavation, pass between the abductors, particularly above the first, forming a tumour under the ischium; whilst, externally, it sometimes escapes between the gluteal muscles, triceps, and *fascia lata*, to project beneath the great trochanter. Hence, we perceive how the fluid of these collections may traverse the whole of the thigh; how it is possible to explain the successive appearance of a number of deposits, by congestion, in the different parts of the limb, as well as the sacculated form which they frequently present; how we may ascertain, by their deep or superficial situation, whether they arise from alteration of the bones of the spine, or from psoitis, or whether they are simply the result of inflammation of the subperitoneal cellular tissue.

From the pelvis the pus may arrive at the groin, across the obturator foramen, by the crural arch, and even across the per-

forated cotyloid cavity, and reciprocally, as I saw in a young man, who died at La Pitié, in 1831, and another, in 1824. I saw one in 1832, where the abscess, forming under the aponeuroses behind the cotyloid cavity, and in the iliac fossa, passed through the inguinal and crural canals and thyroid foramen, then slid between the pectineus and adductor muscles, to encircle the neck of the femur, and point on the superior external third of the thigh. In a fourth the matter, rising in the cotyloid cavity, pursued the same direction, mounting to the posterior border of the tensor vaginæ femoris muscle. We thus see the importance of knowledge of the cellular tracts in diagnoses of purulent collections of the superior fourth of the thigh.

It is worthy of remark, that the bursa mucosa, existing between the capsule of the joint, the body of the pubes, and the iliac tendon, although one of the largest, and the one most frequently drawn upon by the muscles, has been, as it were, forgotten by pathologists. I have here observed collections of serum, sanguineous masses, and fibrous concretions, as in front of the knee. Frequently communicating by a large opening, either accidental or natural, with the hip joint, it there transmits its own affections, or others derived from the vertebral column and pelvis, and may, in its turn, receive diseases, and convey them to the abdomen and iliac fossa; and we not unfrequently find the hip-joint diseased at the same time as the vertebræ, in consequence of abscess from congestion.

Thus reflected over the front of the joints, the psoas and iliacus united support this bursa very solidly. Admirably disposed to flex the thigh upon the pelvis, at the same time rotating it outwards, and, reciprocally, the spine or pelvis upon the limb, they aid, rather than prevent, luxation forwards.

Arteries.—The femoral, nearer the sartorius muscle than those bounding the inguinal canal internally, oblique from above downwards, and inwards, rather nearer the iliac spine than that of the pubes, in its passage under the crural arch, is placed in the substance of the deep layer of the aponeurosis. Posteriorly it reposes upon the pectineus muscle and body of the pubes, in front of the iliac and psoas muscles, the head of the femur, and the anterior surface of the two first adductors, from which it is separated only by aponeurosis. Externally the same fibrous layer alone separates it, superiorly, from the internal surface of the iliacus and psoas muscles, and, below, from the triceps and body of the femur. Internally, it is everywhere contiguous to the vein, which, by degrees, winds behind it.

To obliterate it we must necessarily compress it upon the pubes, the head of the femur, or against that bone, between the triceps and the attachment of the adductors. The first situation affords a very solid point; but as its surface is slightly inclined forwards, pressure must be obliquely backwards. Rather below, that is, on the head of the femur, compression is much more dif-

ficult, unless the thigh is extended. Rounded bodies succeed here better than in the preceding point, as the artery, being placed rather in front of the fissure separating the pectineus from the iliacus and psoas, than on these muscles themselves, is less likely to roll from under the instrument, which would easily penetrate the cavity. Compression against the femur is only practicable in thin persons, or where the muscles are slightly developed. We must then apply the four fingers in the bottom of the inguinal cavity, and the thumb external to the limb, so that the artery may be compressed from within outwards, and from before backwards, at the bottom of the fissure separating the internal portion of the triceps from the psoas and iliacus, and pectineus muscles. Since the publication of Scarpa's works, this region has been selected for the application of the ligature, as the artery is here so superficial that its pulsation may be felt through the skin.

In fact, nothing is more simple when there is neither swelling nor infiltration, and, by incising on the internal border of the sartorius, which rather covers the vessels below, we are sure to arrive at it. If the great saphena vein is there we cannot mistake it, when we recollect that it is always subcutaneous. The femoral vein, being to the inner side of the artery, must be carefully separated from it, and the thread passed from within outwards. An observation, communicated to me by M. Huguier, proves, however, that the femoral artery may sometimes be internal, instead of external. It rarely offers any anomalies, but occasionally divides near its origin, like the humeral, into two branches of nearly equal size. Gooch says that he has met with this two or three times. Heister thought that those individuals who recovered after ligature of the crural artery in the upper part of the thigh, owed their cure to this peculiarity. I once met with this anomaly, which has also been observed by Bell, James, Houston, &c.

The division occurring in the anterior of the pelvis, as in James's case, generally arises from an excessive developement of the profunda, which descends lower and arises higher than ordinary, as in a case under my observation. At other times the two trunks, separated in the groin, unite before they arrive at the poplitial cavity. This was the case in Bell's patient.

When the femoral is replaced by the descending branch of the ischiatic, enormously developed, as remarked in a preparation of M. Manec's, there are only very small arteries in the groin, and wounds or operations would be much less dangerous.

The profunda, maintaining the circulation in the limb when the ligature of the preceding is applied beneath it, is generally given off at about two inches from Poupart's ligament, some-

times rather higher, at others rather lower. Immediately after its origin, it pierces the deep aponeurosis, approaches the femur, and winds in the cellular tissue in front of the psoas and iliacus; subsequently lying on the internal side of the artery whence it arose, entering the femoral region, but always more deeply.

The *internal circumflex*, sometimes arising from the trunk of the femoral, but more frequently from the profunda, passes backwards and inwards, winds round the neck of the femur above the lesser trochanter, between the external obturator and common tendon of the psoas and iliacus muscles, runs between the adductor magnus and quadratus femoris, and is lost in the muscles inserted into the digital fossa of the great trochanter. Among the numerous branches which it gives off in this course, there is not one of sufficient size to produce any great hemorrhage. It is so disposed, that its trunk may be lacerated, in fractures of the neck or luxations of the femur. Whether it comes from the epigastric, as I have seen, or whether, on the contrary, it furnishes that vessel, as observed by Michelet, or whether it arises from the profunda itself, as in Green's case, there would be less danger than might at first be imagined in the operation for strangulated hernia. Although, in the two cases, it would run round a portion of the crural canal, the depth of its origin or its destination would, in some measure, cause the viscera to pass in front. It would scarcely, however, have been avoided in M. Michelet's patient, had the knife been directed inwards. M. Huguier, who has twice seen the epigastric arise from the femoral, at an inch below Poupart's ligament, has also told me, that, in entering the abdomen, it ran along the anterior wall of the crural canal.

The *external circumflex* often arises from a common trunk with the preceding, frequently, also, from the profunda, and sometimes from the femoral. Very large, it passes immediately outwards, between the triceps and rectus femoris muscles. An instrument carried perpendicularly in the bend of the groin, external to the femoral vessels, might, therefore, fall upon it or its principal branches, and produce serious hemorrhage.

The *superficial epigastric*, separating from the femoral, at some lines beneath Poupart's ligament, immediately traversing the superficial layer of the aponeurosis, to distribute itself to the inguinal glands and ascend to the abdomen, is exposed to injury in the operation for crural hernia, and ligature of the femoral artery, at the upper part of the thigh. Being mostly very small, we are rarely obliged to apply a ligature.

The *external pudics* generally emerge through the oval opening in the fascia lata. One passes in front of the *saphena* to proceed to the scrotum, whilst the other, gliding below, is applied on the fibrous envelope of the limb, running towards

the same parts. The first alone would be injured in the operation for crural hernia, and both might be avoided in tying the femoral artery, unless we cut too far from the sartorius muscle.

The *superficial muscular* arises generally from the external circumflex, but sometimes from the femoral, to pass immediately between the rectus and sartorius muscles; where it must be sought after amputation.

The *obturator* belongs to the inguinal region, although arising from the internal iliac; traversing the thyroid canal, it furnishes unimportant branches. One penetrates the hip joint, supplying the cellular tissue, and ligamentum teres. Its two principal branches and their ramifications enter the muscles of the inner portion of the thigh. The posterior anastomoses with the circumflex, ischiatic, &c., whilst the anterior, which is the largest, sends several branches in front across the intervals of the adductor longus and pectineus muscles. It is also very intimately applied on the inner side of obturator hernia.

Veins.—The adherence of the veins to their accompanying arteries and the number of their valves render it difficult to separate them during operations, and prevent their being so liable as others to hemorrhage from reflux.

The *femoral*, applied against the inner side of the artery, and a little behind, is supplied with valves. Its size augments as it ascends; especially, above the inguinal opening in the aponeurosis, from the arrival of the saphena and deep femoral branches. Enveloped in the same sheath as the artery, it may be compressed in the crural canal by hernia; hence the infiltration of the limb produced in some individuals by these tumours. Aneurisms also produce the same effect, by the same mechanism. Its volume renders hemorrhage so severe, and ligature so dangerous, that it might be better to imitate M. Gensoul, and apply the thread upon the artery.

The *saphena*, placed in the deep layer of the subcutaneous fascia, mounts, obliquely outwards, towards the opening in the fascia lata, where it plunges into the crural, receiving the cutaneous branches of the abdomen, and frequently the external pudic. Fortified, externally, by the cellular membrane closing the inguinal opening of the fascia lata, its walls are, consequently, weaker and less resistant at its entrance into the femoral, than elsewhere. Thus it frequently dilates here, and may be mistaken for crural hernia, as observed by J. L. Petit, in a case where the practitioner had applied a truss, or for aneurism, in consequence of the pulsation derived from the artery. As to the cutaneous and pudic veins, they are of no practical importance. It must be observed, that tumours of the groin quickly determine its swelling and dilatation. They formed a tumour of the size of an egg, which had been mistaken for hernia, and for which the woman, whose case I have already

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The *skeleton* comprises the cotyloid cavity and neck of the femur, to which we must add the anterior border of the innominatum, as far as the pubic region.

The central point of union of the three pieces, composing the os innominatum in early life, the *cotyloid cavity* then presents a kind of *cartilaginous triangle* or Y, admitting of rupture. M. Martin found a fourth portion, at a more advanced period. Its relations to the head of the bone, in the upright position,

mentioned, had worn a truss for a considerable time. I have four times met with the dilatation mentioned by J. L. Petit, and that upon four men.

The *lymphatic* glands here form two very distinct groups; one, placed in the subcutaneous fascia; the other, under the superficial portion of the fascia lata, and in the crural canal. The first receives the lymphatic vessels of the external organs of generation, those which ramify in the subcutaneous tissue of the abdomen, and nearly all the superficial of the inferior extremities. Thus, we know, with what rapidity venereal infection gives rise to bubo. Then, there are two orders of pathological phenomena; one, the primitive, produced from a specific cause, passes into the glands; the other, secondary, proceeding as if it depended upon quite a different cause, occurs in the surrounding cellular tissue. Six, eight, or ten assembled in the inguinal cavity around the saphena vein, or in the neighbourhood of the opening in the aponeurosis, they occupy points where crural hernia ordinarily appears. When they are the seat of chronic indolent enlargement, they may easily be mistaken for one of these tumours.

It was thus, that Sabatier applied a truss upon a venereal bubo. Rendered immobile by morbid action, and fixed by the aponeurosis in front of the vessels, they may be raised by the pulsation of the artery, and lead to the belief of the existence of aneurism. Those receiving the vessels of the penis and sexual organs, being all in the bend of the groin, or in front of Poupart's ligament, sufficiently denote, in swelling, that the disease is situated in the genital organs or abdomen, and cause us to suspect that it is syphilitic in character. The others, placed below and internally, do not swell, excepting as a consequence of some disease of the lower limb, and indicate nothing syphilitic in themselves.

The deep glands, three, four, or five in number, surround the femoral artery, situated between the two portions of the *fascia lata*, and communicate with the preceding by means of small arteries, veins, and lymphatics. These pedicles, appearing to transmit diseases from the superficial to the deep glands, render it unusnal for bubos to increase and remain beneath the skin for any length of time, without those in the crural canal being affected. Very much constricted in this canal, they may give rise to more or less alarming symptoms, such as swelling, numbness of all the lower limb, and, sometimes, even to symptoms of strangulated hernia; more than once having led to an unnecessary operation for that accident.

As they may, at the same time, lie along the summit of the hernial sac, it would then be easy, supposing we would tie the pedicle, to comprehend a portion of the intestine in the ligature, as in the case reported by M. Panis. More immediately in contact with the vessels, with the artery in particular,

more deeply seated than the former, covered by a very strong, although cribriform, fibrous tissue, which prevents mobility, they may thus, in developing, resemble aneurism. Swelling and inflaming around a crural hernia, they lead to considerable embarrassment in the operation, as there may be a small abscess, which we are obliged to traverse to arrive at the sac. In 1831, I experienced these difficulties, in exposing the femoral artery for aneurism. Their extirpation, is always a delicate operation, in consequence of their relations to the vessels. In removing one, about the size of a small egg, I was obliged to lay bare the saphena vein at its entrance into the crural. The inferior or crural glands, would not lead to the same dangers, as they do not lie in the course of the artery.

Nerves.—The *inguino-cutaneous* lies in the superior external angle of the region, between the origin of the muscles, and divides into a considerable number of branches, which pierce the aponeurosis, to supply the subcutaneous tissue and skin.

The *obturator* proceeds exactly like the artery of the same name. Its distribution and situation in the pelvis explain the intense pain and cramps experienced by some women, in the inner part of the thighs, towards the end of gestation, or during labour.

The *femoral branch of the genito-crural*, ramifies in the canal of that name, lost, as it were, in the cellular tissue and lymphatic glands filling it, and lies behind the sac in crural hernia. Although small, it may be so compressed as to produce pain in the iliac fossa and loins. All precautions for its preservation are useless in the operation for strangulated hernia.

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and in falls, account for fractures of its edges, or even walls, hitherto not described; but which are, nevertheless, very common, since M'Tyer met with four examples in dead bodies, in a very short time, at the Infirmary at Glasgow, and I myself three, during 1835-6. The external violence had fallen principally upon the great trochanter, in the patients submitted to my observation. Extending from the cotyloid cavity, the fracture had isolated the three primitive portions of the innominatum, although one of the patients was forty-five years of age.

Encrusted by a smooth cartilage in its superior four fifths, and receiving in the rest of its extent a cellulo-adipose mass, considered by Havers as a secreting organ of the synovia, and forming a perfectly rounded cul-de-sac, the entrance to which is circular, the cotyloid cavity admits, on the one hand, of motion in all directions, and, on the other, supports the weight of the body without fatigue, or pressure upon the cellular tissue enclosing the nerves and vessels. Containing a greater proportion of soft parts, it easily inflames. Without saying, with J. L. Petit, that the synovia, accumulated within it, forces out the head of the bone, we must at least admit, that this bone sometimes slips out, in consequence of the synovial membrane swelling, that the ligaments soften or become disorganised, and the bones themselves destroyed. In the case reported by Burns, Havers' glands were transformed into fungus hematoides.

Its notch, although surmounted by a fibrous band, by which it is, in a great measure, effaced, nevertheless, in an especial manner, predisposes luxation of the femur. These displacements are, however, very difficult, as, being surrounded by dense tissue, and a capsule but little susceptible of lengthening, they cannot occur unless the sac be ruptured, which is much more feeble behind than before, where the resistance is more necessary.

When the *luxation* occurs in front, the head of the femur raising the psoas and iliacus muscles, the femoral nerve, vessels, and aponeurosis, and drawn upon the triangular fossette of the pubes, cannot pass more externally, in consequence of the ilio-pectineal eminence, and anterior inferior spinous process of the ilium, which are more elevated. Neither can it ascend into the pelvis, nor on the median line, because the neck of the bone, on the other hand, and the trochanter major, on the other, arrest it, abutting against the border of the cavity, of the external surface of the ischium. The point of the foot is then turned outwards, by the simultaneous action of the glutei, psoas and iliacus, adductors, and all the muscles inserted into the digital fossa of the great trochanter. Always producing shortening, this luxation may give rise to serious mis-

chief, by compressing the crural nerve and vessels. When the displacement occurs downwards and inwards, there is, on the contrary, lengthening, since the bone is placed in the obturator fossa, which is below the cotyloid cavity. The inter-articular ligament, then oblique from above downwards, instead of being from below upwards, is not necessarily torn, as in the preceding instance. Enveloped by the external obturator muscle, the head of the femur compresses no organ of importance, and where reduction is not effected, we can imagine, that the thyroid membrane may ossify, an accidental cavity form, and the patient be able to use his limb, which remains turned outwards, in consequence of the tension of the adductor muscles.

Whether the luxation outwards is at the same time primitively upwards, or at first inferior, there must still have been considerable adduction, for the situation of the thighs to allow it. Moreover, the edge of the cotyloid cavity is so elevated, and the capsular ligament so strong, in this situation, that we need not be surprised at their unfrequency. The head of the femur sliding between the lesser gluteal and the external surface of the innominatum, where it lodges, the gluteus medius and other internal rotators turn the point of the foot inwards. In these two latter, the sartorius, rectus femoris, psoas muscles, &c. being drawn upon, and the extremity of the femur placed at a point posterior to that which it habitually occupies, the limb is more or less bent. The absence of the round ligament, observed on both sides of the same subject by M. Pailloux, would render these accidents much more frequent. The forced flexion, in which the thighs are placed during fœtal life, explains, better than the pretended arrest of developement, of which there is so much talk at the present day, the congenital luxation of the femur. That which proves, that such is the cause, at least, very frequently, of the latter kind of displacement, is the fact of my having seen it in two individuals, one thirteen, the other twenty-seven, and the disease which destroyed them having kept them bent for more than six months.

Whatever may have been said, the head of the femur may be dislocated upwards and forwards, as Physick has twice seen, downwards and backwards, or directly downwards, and even incompletely, as Mance has proved from dissection. It is also positive, that, arrested upwards and inwards, it need not produce any deviation in the point of the foot, whilst it causes an elongation of nearly four inches.

The bottom of the cotyloid cavity is so thin, that it would easily be traversed in disarticulation of the thigh, and the point of the knife thus plunged into the pelvis. Caries and necrosis may also perforate it, as too frequently occurs in white swelling. If the pus does not escape into the pelvic cavity, it is because the soft parts, spreading as the disease advances, condense, and thus oppose a more or less solid, but not always

insurmountable barrier. After unreduced luxation, as after disarticulation, the cotyloid cavity gradually contracts, and is sometimes almost completely obliterated. The corresponding points in the interior of the pelvis then appear to project inwards, so much so as to contract one of the oblique diameters of the superior opening. The same thing is also seen after amputation of the thigh, inasmuch as the articular cavity, having nothing more to support, retires towards the pelvis.

This obliteration, which does not always occur, even in congenital dislocation, is far from being so rapid or complete as has generally been considered.

The length of the neck of the femur is about two inches and a half below, and only an inch above, between the articular head and the great trochanter. Thus separating the superior portion of the femora, it allows of the greatest number of the muscles of the thigh, and all the organs requiring protection from the bones, to be assembled in their interval. In this manner, the weight of the body, falling upon the head of the bone, tends to force it downwards, whilst, by the resistance of the ground, the great trochanter is pushed towards the iliac crest. Two forces applied in inverse directions, on the two branches of a bent lever, could not act in a more advantageous manner for the production of its rupture. If a violent blow or a fall occurs on the external surface of the great trochanter, the two forces, represented by the weight of the trunk and that of the limb, strongly tend to produce separation of the two branches of this angular lever, since its curve serves as a point of support.

As the neck is very large near the body of the femur, much thicker, consequently, from above downwards, the direction in which fracture occurs, than towards the head of the bone, fractures should be more frequent in the latter point than in the former; the periosteum, thinning more and more as it approaches the cartilage, on its side renders consolidation much more difficult and less prompt in that direction. Several authors have even advanced that it is impossible, observing, that the head of the bone then becomes a mere foreign body in the articulation. In some old persons, the fact is precisely so, and the head of the femur, from friction, diminishes daily. Hence the theory advanced by Sir A. Cooper, that fractures of the upper part of the neck of the femur do not unite, and that, consequently, it is useless to apply bandages, &c.

If the fracture occurs lower down, the fibrous expansion may possibly remain untorn over the two portions, which are then capable of consolidation.

The displacement is never very great, unless the capsule be torn, or where the fracture is situated very close to the body of the bone. As the action of the glutei could, in reality, only produce very limited shortening, also arrested by the attachments of the capsule, the difference cannot be very great, whether we leave

the limb to itself, merely fixing it to a pillow, as was the practice of M. Haubert, whether we keep it in permanent extension, or, as I habitually do, allow the patient to walk upon crutches from the commencement. When, however, the inferior fragment is carried by the adductors, or in any other manner, on the body of the pubes, the muscles retain it there so forcibly, and there results so much shortening, that we might at first mistake it for luxation, whilst its reduction requires considerable extension.

The obturator, gemelli, pyramidalis, quadratus, psoas and iliacus, adductors and pectineus, being all inserted in the upper part of the femur, so as to turn it outwards, were it not maintained by the cotyloid cavity, the external rotation of the point of the foot and knee, which we then remark, is a perfectly natural phenomenon. The shortened fasciculi appear like an oblong tumour, frequently manifested in the bend of the groin, and have been given as a diagnostic sign of a fracture of the neck of the femur, by Desault and Haubert. The fibrous capsule is so disposed, that, cut circularly over the neck of the femur, the opening would be too narrow to allow of the head of the bone escaping without a considerable effort. Thus, to avoid great difficulty in amputation of the hip joint, it is absolutely necessary that we divide very near the cotyloid margin, and cut perpendicularly upon the head of the bone. With regard to this operation, we must remark, that the body of the femur, in uniting to the neck, forms, internally, a deep groove. The femur being convex, subcutaneous beneath the great trochanter, presenting only a narrow fissure between this eminence and the cotyloid cavity, the external flap is always thinner than the internal; and if we commence by it, we are more likely to bungle than if we began by the other. To judge of the respective value of the various methods recommended, we should recollect the disposition of the soft parts.

The limb being removed, some branches of the sciatic, gluteal, and internal pudic, as well as the obturator artery, will be found in the external flap. Other arteries, less numerous, given off by the same branches, and sometimes by the external pudic, will be met with in the internal flap. We shall, also, have branches furnished by the two circumflex arteries of the thigh, in the first situation, and, in the second, the femoral and profunda only, or the circumflex, pudic, superior perforating, superficial muscular, which arise from it. The hemorrhage is by no means in proportion to the extent of the wound, as I proved in two instances, where I performed the operation.

Remarks.—With such a diversity of elements, it is not surprising that the groin should be the seat of various diseases, and, especially, of numerous tumours; in fact, each layer, in this respect, has its peculiar importance. Among the numerous treatises written upon this subject, it is unfortunate that the

authors have not made a more direct application of anatomy to the affections of which they treat, as, in fact, it nowhere explains so many phenomena.

The skin, more adherent to the bottom of the inguinal fissure than elsewhere, explains the secretion and excoriation remarked in infants and fat people. Thin and incessantly moving, loss of substance from burns, or otherwise, leave cicatrises, which, transforming into bands, considerably interrupt extension of the limb. The adhesions established between it and the aponeurosis, by disease of the subcutaneous tissue, also show, how tumours, crural hernia among others, then manifested, may be forced to deviate either internally, resembling inguinal hernia, as observed by Marjolin, or externally, as in the case cited by Larrey. The tension of the entrance of the crural canal, during exertion in the upright position, re-acting on the veins, accounts for the swelling sometimes presented by the saphena and cutaneous veins in the inguinal cavity; in the same manner that the melange of these veins with the small glands and fat, in front of the vessel, gives the idea of hydatids, sanguineous tumours, glands, abscesses, and varices, which have more than once been mistaken and operated upon for strangulated hernia. The glands, placed internal to or beneath the crural canal, communicating only with the lymphatics of the limb, whilst those above are in relation with the sexual organs, also admit of the seat or real cause of disease being determined, when they swell. The subcutaneous fascia, less adherent and less aponeurotic, internally, in women than in men, whilst the inferior border of the falciform process of the fascia lata is stronger and more raised in the former, inguinal and crural herniæ are easily confounded. The adipose cells of the crural canal explain the frequency of adipose tumours in front of this hernia, and the signal mistakes which have been made; as, also, osseous productions, whether rounded or crest-like, as I have seen in front of the cotyloid cavity, giving the idea of luxation or fracture. In consequence of the abundance of cellular tissue around the articulation, suppuration may occur over an aneurism, and up to a certain point excuse those who, like Cullevier, have plunged the knife into the vascular sac, thinking to open an abscess.

SECTION SECOND.

OF THE THIGH.

This portion of the limb, limited, superiorly, by the inguinal and gluteal regions, inferiorly by the knee, is slightly flattened on its antero-internal and postero-external surfaces, when the

limb is flexed. In extension, on the contrary, it is prismatic, or rounded and conoid, especially in females. In man, it is more or less convex, anteriorly and externally. In very muscular individuals, we here remark a series of reliefs and depressions, corresponding to the muscles and their intervals.

The *anterior region* of the thigh, very convex, presents a kind of superficial gutter, which appears a continuation of the inguinal cavity, and corresponding in direction to the artery.

The *skin*, covered with hair in man, in the external and anterior half, is similar, internally, to that in the groin. Very mobile, it is perfectly disposed to union by first intention, whether by aid of plaster or bandages.

The *subcutaneous fascia*, more regularly lamellous than in the groin, is, in other respects, disposed in the same manner. The fascia lata, extremely strong externally, single over the vastus externus muscle as far as the rectus, which it envelopes, splits, forming a complete canal for the sartorius muscle, as also for the gracilis. Its deep layer increases in thickness as it plunges into the femoral fossa. Its lamellæ enveloping the crural vessel, and two nervous branches, we must, when we would arrive at the artery, put aside the sartorius, and divide an aponeurotic layer, in no way differing from that described in the inguinal region, except in being thicker. Internal to the vessels, this membrane raises itself in front of the adductors, and unites to the superficial layer; therefore, towards the middle of the thigh, cutting too much external to the sartorius, we must not expect to find a double aponeurosis, as over that muscle, or close to its edges. Finally, the fascia lata is so well applied on the muscle, that, in deep and narrow wounds, a kind of muscular hernia may form across it. Moreover, in consequence of its thickness, it occurs, first, that, in inflammation of the subcutaneous tissue, the pus extends with extreme facility from one end of the thigh to the other; and that here, more than anywhere else, *numerous* and *deep* incisions are the best methods of stopping the progress of erysipelas phlegmonoides; secondly, that deep collections, restrained by such an obstacle, flow towards the centre of the limb, dissecting the muscles, rather than becoming superficial, whence the importance of creating a large issue as early as possible in all similar cases. Thinner, and, as it were, rarified internally, the aponeurosis allows greater facility to the formation of abscess, and the transformation of superficial inflammation into deep, or reciprocally. The sheaths which it furnishes are the same as in the inguinal region, and require no lengthened observation. Those of the psoas and iliacus not reaching so far, deposits, capable of traversing them from below upwards, would not enter the pelvis by the iliac canal, and those descending by this would almost always stop in the groin.

Muscles.—The *sartorius* is the most important. Enveloped in its fibrous sheath, it contracts, and moves independently of al'

the others. As it is slightly concave in front and externally, the artery is nearer its internal than external border superiorly, and the reverse inferiorly. The intersections occasionally observable so much the more augment its power. If it were wanting, or double, as observed by Meckel, we may imagine the difficulties which might result in operations on the artery. As the extent of motion in the muscles depends upon the length of their fibres, the sartorius would retract considerably if cut across. It is, besides, so near its vessels, that this division, as the result of a wound, could scarcely occur without endangering the artery.

The *rectus femoris* here presents almost the whole of its fleshy portion. Enveloped, also, in fascia lata, but less completely than the sartorius, it is free, and contracts without the participation of the triceps. Such is the obliquity of its fibres, that the internal cross those of the sartorius at right angles. As the extension of the limb almost alone depends upon it, its strength, although very great, will not always suffice to prevent rupture.

The *triceps* is so placed that its external portion, very large superiorly, joined to the convexity of the femur in front and externally, determines the natural prominence, presented by the thigh in that direction. Its internal portion being, on the contrary, largest below, thus augments the concavity of the middle and superior portions of the limb internally. It is this latter portion, which, uniting with the tendons of the adductors, forms the bottom of the gutter, containing the femoral vessels. The *cruralis*, hidden by the rectus, completely envelopes the front of the femur, as the internal and external vasti cover the sides. The triceps, attached over the whole length of the bone, becomes, in consequence, in fractures at the middle of its length, one of the principal methods which nature opposes to displacement. The fibres of the vastus internus, oblique from above downwards, forwards, and outwards, approach more to the transverse direction as they descend. Consequently they can scarcely be confounded with those of the sartorius. The *gracilis* continues along the internal border of the thigh; enclosed in its canal, it offers nothing in a surgical point of view. A portion of the three *adductors* forms the internal mass of this region; the middle, at first, conceals a large part of the two others. All attached to the linea aspera, between the vastus internus and short portion of the biceps, they give origin, in spreading, to a very strong aponeurosis, which is principally remarked over their anterior surface, and is confounded with the deep layer of the sartorius. It is this lamina which has been designated *aponeurosis of the adductor magnus*, although it is rather a dependence of the adductor longus. In consequence of their insertion backwards, they turn the foot outwards when they act singly, at the same time tending to approximate the two thighs.

All their fibres being oblique outwards, they may easily be recognized, if by accident we should fall too much internally in looking for the femoral artery. Lastly, we must remark, that the adductor magnus presents in its internal border, a tendon, which gradually isolates, and is prolonged as far as the condyle of the femur.

Arteries.—The *femoral* gradually approaches the internal border of the thigh, as far as the union between its middle and inferior third, where it passes backwards, and takes the name of popliteal. With its aponeurotic sheath it is lodged in a canal, formed by the vastus internus near the femur; by the tendinous portion of the adductors internally; by the union of these latter with the triceps near the linea aspera; finally, in front by the sartorius, which, leaving it free to the extent of an inch or two above, advances gradually over it in descending, so that, before traversing the adductors, it is placed almost immediately beneath the middle of its internal surface.

To apply the ligature at the point recommended by Hunter, we are obliged to put aside the sartorius, whether we cut on its external or internal border, or whether we cut down upon its anterior surface. The integuments and aponeurosis covering this muscle being divided, we should push it internally, and we shall then see the artery enveloped in its sheath at the bottom of the wound. It is now of importance to recollect the direction of the fleshy fibres; the incision commenced too far externally, or the knife too much inclined in that direction, would divide the *fascia lata* before it splits. Falling on the rectus femoris, or vastus internus, the surgeon would in vain divide the fleshy fibres as far as the femur; he would not meet with the artery.

Pupils practising operations on the dead body frequently fall into this error; and, moreover, the artery is generally rather nearer the external than internal border of the sartorius. The canal furnished for it by the deep portion of the aponeuroses in no way differs from that in the groin, as far as the middle of the thigh. A little below, its anterior wall becomes extremely thick, being strengthened by the lamellæ detached from the front of the tendinous portion of the adductors, to unite to the internal surface of the triceps, near its attachment to the femur. Entering the popliteal space, therefore, the femoral artery does not emerge from a simple fibrous ring, but rather from a long canal, prolonged superiorly as far as the iliac fossa, but which becomes strongest and most complete opposite the two last adductors. It is thus sheltered from all compression, during the action of the muscles. Its sheath encloses, in addition, the vein, internally, and sometimes two nervous branches, or, at least, the internal saphena nerve, and cellular tissue, forming a layer for each of these organs, and a general investment for the whole.

The opening by which the vessels enter the popliteal region being at about five inches above the condyle of the femur, the incision for the ligature of the artery should not be made too low, but must be prolonged, at least, as much into its middle as inferior third. In consequence of the investment furnished by the adductors, it is not always easy to secure and tye it, after amputation at the inferior third of the thigh. I may add, that M. Huguier informed me, that, instead of finding it externally in front of the vein, he once met with it internal, from the groin to the ham.

The *profunda* terminates by the perforating, which present no other interest in surgery than from their anastomoses with the obturator above and the articular below. The *anastomotica magna*, forgotten in some of our works, furnished by the trunk of the femoral before its passage through the third adductor, sometimes arises two or three inches higher. Being sufficiently large, in some individuals, to form a very free anastomosis with the internal inferior articular, it shows the advantage of placing a ligature beneath, rather than above, whenever the disease allows of selection. It also more frequently requires a ligature after amputation of the thigh than the perforating and superficial muscular, ramifying between the rectus femoris and cruralis. With regard to the anomalies, I have only to observe that those occurring in the groin are met with in the thigh, where they are subject to the same surgical considerations. The profunda, instead of arising very high up, sometimes does not separate from the femoral until about the centre of the region; Blandin cites one example, and I possess two others. In this case, the ligature, applied with less danger upon the principal trunk near Poupart's ligament, would be attended with inconvenience so near the termination of the adductors.

Veins.—The *internal saphena*, always contained in the deep layers of the subcutaneous tissue, not being surrounded by any nerves here, would appear to indicate, that in those cases where we would treat varices of the leg by ligature or division, the operation on this account would be less dangerous above than below the knee.

The *femoral vein*, enclosing but few valves, and, nevertheless, but rarely presenting varicose dilatation, is enclosed in the same sheath with the artery, of which it partakes the general relations already described, rarely offering any anomaly. I, however, saw a very remarkable case, in 1825; the two vessels proceeded in their natural position, for about five inches beneath Poupart's ligament; the vein then separated from the artery internally, instead of placing itself externally, as in the case mentioned by Huguier, and obliquely traversed the fleshy portion of the adductor longus muscle, at about two inches inferiorly, to enter the posterior region of the thigh. Arrived in the popliteal space, this vein resumed its ordinary situation;

I met with a similar variety in 1829, and it is evident that it would be extremely advantageous in tying the femoral artery, but that a wound in the internal third of the limb would then easily produce exceedingly abundant venous hemorrhage.

The superficial and deep *lymphatics* pass into the corresponding inguinal glands, which, consequently, swell and inflame very rapidly in most of the inflammatory diseases of the anterior of the thigh, and the whole of the lower extremity.

The *nerves* all belong to the crural, and are the same as in the groin. Numerous filaments traverse the fascia lata to ramify in the subcutaneous tissue, and terminate in the skin, whilst others are distributed to the muscles. The two branches accompanying the femoral artery remain the same as they were above, up to the moment when this vessel enters the oblique canal, between the adductor tendons. The proper *femoral nerve* then raises itself a little over the internal surface of the triceps, and continues to descend towards the knee, whilst the *saphena* accompanies the artery as far as the popliteal cavity. Gliding, at first, between the adductor magnus and the sartorius, subsequently between that muscle and the gracilis, before becoming superficial, it might easily be comprehended in the ligature of the femoral artery, at whatever point of the thigh the operation were performed.

Prolonged rather more than the preceding towards the pelvis, in consequence of the fold of the nates, or of the sub-ischiatic fissure, the *posterior region* of the thigh is, in general, regularly rounded, excepting below, where it presents the origin of several eminences and depressions found in the popliteal cavity.

The *skin*, neither so delicate as internally, nor quite so dense as externally, is generally more extensible, and allows tumours, developed beneath, to acquire enormous size, without necessarily producing disorganization. In man, it is covered by a great quantity of hair, and encloses numerous follicles.

The *subcutaneous tissue*, at once thick, filamentous, and of very loose texture, enclosing a large quantity of fat, is easily dissected and separated from the aponeurosis, excepting always in the fissure corresponding to the point of union betwean the vastus externus and the biceps, where its lamellæ are more condensed. Fibrous, as it were, in this point, its adherence to the fascia lata is sufficiently strong to merit some attention, when we endeavour to raise the skin in amputation. Continuous, without any line of demarcation, with the adipose layer of the haunch, and with that of the anterior crural region, being, moreover, more elastic and thick than in front, infiltration and abscess form rapidly, and fluids arrive easily from other points, whilst inflammation or phlegmonous erysipelas produces immense destruction. Containing neither artery nor nerve of any importance, we may cut

deeply and freely without danger, to empty or prevent these collections.

The *aponeurosis*, taken at the external part of the thigh, that is to say, where it extends from the vastus externus to the linea aspera, splits near the biceps, semi-tendinosus, and semi-membranosus muscles; one of its portions passing behind, whilst the other extends over their anterior surfaces. These three muscles are thus enveloped in a fibrous canal, which divides, inferiorly, into two distinct sheaths; one for the biceps externally, the other for the semi-membranosus, and semi-tendinosus, internally, where they separate to circumscribe the popliteal space.

Muscles.—The *biceps*, at first hidden over the ischium by the gluteus maximus, prolonged from the femur and adductor magnus by a space of at least an inch, near its origin, gradually approximates as it descends. Passing slightly outwards, it receives, on its anterior border, the fibres of its short head, in entering the popliteal cavity, of which it forms the external border. When the limb is bent, we perceive, between the biceps and the vastus externus muscle, the commencement of the external femoro-condyloidean fissure, where the subcutaneous tissue is most adherent. We perceive that, by its long portion, the biceps is admirably disposed to act with energy on the ischium and the whole of the pelvis, to which it is one of the strongest extensors, and the firmest support in the upright position. The *semi-membranosus* and *tendinosus*, arising from the same point as the biceps, also, descend in the same fibrous canal, one in front of the other, before possessing one peculiar to themselves; when they immediately separate, leaving between them the commencement of the *popliteal cavity*. During flexion of the limb, these two muscles form below a prominent cord, depending principally on the semi-tendinosus, and separated from the gracilis muscle by an indistinct fissure. They are, like the biceps, prolonged from the adductor magnus, by a space circumscribed, behind, by the anterior portion of their sheath, in front, by the posterior surface of the adductor magnus, internally and externally, by the internal surface of the aponeurosis arriving at the limits of the region. This kind of *canal*, becoming flattened towards the popliteal cavity, is continuous, superiorly, where it is largest, with the ischio-trochanteric notch, and appears, from this circumstance, to take its origin in the pelvis. Being filled by lamellous, elastic, and loose cellular tissue, inflammations may easily occur. The pus formed in the upper portion tends continually to spread downwards, and in fact frequently does so; and may also extend here from the interior of the pelvis, at first, by the cellular interstice existing between the superior border of the adductor magnus and the quadratus femoris, when the abscess is developed in the sub-obturator ex-

cavation; subsequently, by the great sciatic notch. A patient aged eighteen, admitted into the Hôpital de la Faculté, on the 20th June 1824, suffered from an abscess of this character, at the superior and posterior portion of the left thigh, and I have since frequently found this communication on the dead body. It is evident, from this disposition, that three sorts of abscess may occur at the back of the thigh; first, between the aponeurosis and skin; secondly, in the sheath of the superficial muscles; thirdly, between this sheath and the attachment of the adductors to the linea aspera.

The *arteries* are merely unimportant branches of those already studied in the gluteal, inguinal, and anterior femoral regions. The ischiatic furnishes, superiorly, a branch of some magnitude, which winds beneath the ischium to reach the perinæal region, and gives off another, apparently the continuation of the trunk, descending between the two layers of muscles, as far as the ham, and, most commonly, requiring ligature after amputation. Surrounded by very loose cellular tissue, it retracts considerably, and is not always easily found. In a preparation belonging to M. Manec, it is as large as the femoral. More deeply and internally, are some branches of the internal circumflex, coming through the adductor magnus, and, also, some supplied from the obturator artery. The perforating, arriving directly in the cellular space, separating the posterior surface of the adductor magnus from the other superficial muscles, to supply the latter, anastomose among themselves, with the obturator or circumflex, and are the resource by which the circulation is continued, when the femoral is obliterated near the profunda.

Veins.—The posterior branch of the saphena is sometimes found in the back of the thigh. The other subcutaneous veins, having no fixed distribution, often produce, beneath the skin, that marbled appearance so common among females. As to the deep veins, they accompany the arteries, and deserve still less attention than the superficial.

The superficial lymphatics gradually wind round the internal border, and enter the anterior femoral region of the thigh. The deep, also, for the most part, enter this region with the arteries. Some mount to the ischiatic notch, and thus penetrate the pelvis. Disease of the skin and subcutaneous tissue may, consequently, produce swelling of the superficial glands of the inguinal region. Reacting on the deep-seated glands of that region, inter-muscular disorganisations may also determine swelling of some of those of the pelvis.

Nerves.—Notwithstanding the lesser sciatic, obturator, and crural send branches here, which proceed nearly as their corresponding arteries, the great sciatic is the only one which need particularly fix the attention of the surgeon. The largest nerve of the body, enveloped in the cellular tissue of the ischio-popliteal space, it ordinarily descends without bifurcating to the spot

where the biceps and semi-membranosus separate to gain the middle of the thigh. Its position is such, that it may easily be compressed when we sit upon an uneven seat, or on the edge of a chair, producing numbness in the whole limb. Furnishing no remarkable branch, sensibility depends here upon the first-mentioned nerves. It always encloses an artery, sometimes sufficiently large to require a ligature after amputation, and which gives off sufficient branches to the nervous filaments, or, rather, to the neurilemma surrounding them, for this cord to be exceedingly predisposed to all the diseases of which nerves in general are susceptible; consequently, neuralgia of the lower extremity is the most frequent and dangerous, its importance not admitting of a portion being removed for the cure of the disease. M. Malagodi, however, operated once in this manner, in 1828, and says, that the patient preserved the use of his limb. In 1836, I successfully removed a scirrhous tumour, as large as an ostrich's egg, which was encysted in it beneath the ischium. In this case, however, there was no paralysis either before or after the operation; and it was the same with a steatoma, weighing eight pounds, which had converted the nerve into a membrane.

The *skeleton* of the crural region comprehends the body of the femur and the trochanters. Padded by thick and numerous muscles, this bone is thus protected against direct causes of fracture; but its thickness diminishing towards the centre and its length predispose it, more than any other, to indirect fracture. The weight of the body on the one hand, the resistance of the ground on the other, striking, if we may so say, on its thinnest and most curved point, render fractures easy.

From this disposition, the flexor muscles of the leg are so much prolonged from the axis of the femur, that they tend to augment the concavity, whilst, on the contrary, those lying on its anterior surface oppose this so violently, in their sudden contractions, that fractures by simple muscular action are by no means difficult to be understood.

The muscular arrangement causes *fractures* of the body of the femur to be of two kinds, with respect to the subsequent displacement. They occur at the upper half, and, yet, beneath the lesser trochanter, or in the lower half, and then above the popliteal cavity. In the former, the action of the pectineus, psoas, and iliacus muscles predominates, and the upper portion of the bone almost constantly passes in front of the other. In the latter, on the contrary, the gluteus maximus on the one hand, and two of the adductors on the other, overcome the preceding muscles, by drawing the same portion backwards, whilst the inferior, pulled by the adductor magnus, semi-tendinosus, semi-membranosus, and biceps, is dragged by the triceps and rectus, which tend to make it overlap the front of the upper portion.

If we may easily understand the considerable riding, sometimes observed in these fractures, from the length, number, and

power of the muscles passing from the pelvis to the leg, without being attached to the thigh, we may as easily imagine, if we consider the power of the biceps and adductors, as well as their attachments to the femur, that, in other cases, there is scarcely any displacement.

The curvature of the femur should be particularly studied, when we would apply any extending apparatus upon the thigh. Perhaps this curve is one of the greatest obstacles to fractures being cured without deformity. However effectively we may have removed the riding by any of the known methods of extension, the power being applied in a straight line, we generally find that this curvature is more or less diminished. Whether we merely use Scultet's bandage, or pillows, firmly pressed on the internal, external, and anterior surface of the thigh, or whether we fix the injured limb against the sound, the same effect will be produced; the bone will be more or less shortened, and the two extremities of the fracture may project backwards.*

As the principal aim of surgeons, in the various methods proposed for *amputation* of the thigh, is to avoid the projection of the bone, I must be excused for briefly considering this subject. In whatever manner we operate, we can never prevent the retraction of the rectus, sartorius, gracilis, biceps, semitendinosus, and membranosus muscles. Enveloped in as many fibrous sheaths, taking their fixed points at the pelvis, these muscles retract most when the amputation is performed near the knee. Consequently, we should divide the integuments as far as possible from the point where the femur is to be sawed, when we operate low down. The triceps and adductors, on the contrary, being one with the bone, cannot, in any case, retract far.

To obtain an advantageous result, we should, therefore, not only cut the superficial muscular layer very low down, but, also,

* This shortening of the limb after fracture is by no means so general a rule as M. Velpeau seems to imply, as every-day experience proves; neither do I consider that the femur need permanently be deprived of its convexity. The facility with which the reduction is effected depends upon the position in which we place the patient's limb, and the direction in which we make the extension. If we attempt reduction whilst the limb is extended, we shall, I may say, almost invariably fail, as the muscles being all extended, and, consequently, all endeavouring to contract, will resist our efforts, unless we employ greater force than is compatible with the welfare of the patient; but if we previously flex the knee, and bend the thigh upon the pelvis, we, by that means, place most of the principal muscles in a state of relaxation, and may then have perfect command over the broken portions, and attain our object with comparative facility to ourselves, and certainly with less inconvenience to the patient; the convexity of the femur may always be preserved by having the splint properly padded. The aim of the surgeon, after the bones have been returned to their apposition, is to keep the limb at perfect ease, placing it in such a position that the muscles may be at rest, but not keeping up extension, as that should be passive; merely preventing contraction, without actively stretching the muscles. The best apparatus is Mr. Amesbury's double inclined plane, with my addition, by which all this may be obtained. The limb being perfectly quiescent, it requires but little trouble to keep it so, but, in Desault's straight splint, the muscles being kept upon the stretch, there is a continual warfare between them and the instrument, and then it is that the inconvenience mentioned by M. Velpeau occurs.—H. H.

favour immediate retraction; subsequently dividing the deep layer as high as possible. The whole question is contained in this. The length of the muscles of the thigh generally render its amputations serious, in consequence of the purulent infiltrations which they favour in an especial manner.

When the diseased portion of the limb is removed, the following is the order of parts, taking the bone for a centre: first, anteriorly, the middle portion of the triceps and the rectus femoris, separated by a layer of cellular tissue, commonly containing the muscular artery: secondly, posteriorly, the attachment of the adductors, a thick cellular layer enclosing some of the branches of the perforating arteries, the biceps, semi-tendinosus and membranosus muscles, with the great sciatic nerve; the nerves, possessing no power of contraction, sometimes project through the wound after amputations: thirdly, externally, the vastus externus alone, without any arteries: fourthly, internally, lying immediately upon the bone, the vastus internus; subsequently, the adductors; between them, the femoral artery and vein; next, the sartorius muscle, enclosed in its sheath, and the gracilis, also contained in its investment.

Resection.—Thus we observe that, externally, the thigh encloses neither arteries, veins, nor nerves of any importance. The bone, covered by the vastus externus or aponeurosis, is there more superficial, as its natural convexity is turned in that direction. It is, consequently, here, that we must expose it, when we would remove or refresh the ends, in cases of unconsolidated fracture, or cut away the superior portion, as performed by several surgeons; create an anormal articulation in anchylosis, after the manner of Barton and Rogers; and, lastly, remove splinters or sequestra.

Projecting for about an inch above and half an inch behind the neck, the *trochanter major*, giving attachment to the middle and small glutei, covered by the anterior edge of the gluteus maximus when the thigh is bent, is, on the contrary, nearly subcutaneous during extension of the limb. A bursa mucosa, commonly very large, is found between its external surface and the skin, or, rather, between its posterior border and the gluteus maximus muscle. As this is subject to the same diseases as other bursæ mucosæ, its presence, to a certain extent, explains the caries and necrosis by which the great trochanter is frequently affected.

The anatomical relations of this process render its removal very easy; but the surgeon must not forget the attachment of the gemelli, pyramidalis, and obturator muscles, nor the elasticity and abundance of the cellular tissue placed behind the neck of the femur.

SECTION THIRD.

FEMORO-TIBIAL REGION.

This portion of the abdominal extremity very exactly represents the elbow. Its form is very irregular, and difficult of description. It presents two regions, one anterior, the other posterior; the *knee* and the *popliteal cavity*.

Of the *knee*.—Externally, the knee offers, in the middle, a very marked prominence, much larger in semi-flexion than in complete extension or flexion, having its apex directed downwards, corresponding to the patella. Above and below, the limb in extension, and the muscles quiescent, we find a cavity, upon each of which we apply a graduated compress when we would approximate the two portions of a fractured patella. When the muscular contraction occurs during semi-flexion, each of these two cavities is divided into two fossæ; one by the tension of the ligamentum patellæ, the other by that of the rectus femoris muscle. Beneath the inferior, we remark another immoveable eminence, which is continuous with the crest of the tibia. Laterally, we perceive, internally, a third cavity, parallel to the axis of the limb, and continuous, superiorly and inferiorly, with the internal fossæ of the two preceding depressions. An instrument introduced at one of these points penetrates directly into the articulation, or, rather, into the synovial cavity. Fluctuation in hydarthrosis is most easily felt here. More posteriorly is an eminence, formed by the internal condyle of the femur, itself presenting two others; one, anterior, bounds the preceding gutter; the other, posterior, forms a portion of the internal border of the popliteal space. Beneath these two tuberosities, we feel a narrow transverse fissure, conducting directly into the joint; subsequently, a little below, the internal condyle of the tibia, continuous with the inner border of that bone. Superiorly, this eminence is prolonged by a kind of cord, easily distinguished when the limb is semi-flexed, and corresponding to the tendon of the adductor magnus; in front of which we remark the relief formed by the vastus internus. Externally there is likewise a gutter, only well marked during extension, and lost in the two external fossettes of the cavities at first indicated; the superior, corresponding to the interval separating the species of tendon of the vastus externus from that of the rectus femoris. A little more externally, we see a projection, formed by the external condyle, but smaller than the internal; below, we remark a small fissure, placed transversely, also indicating the articulation; finally, the external condyle of the tibia, externally and inferiorly, the head of the fibula, are the last objects to be noticed.

These peculiarities, which may be observed at the first glance,

lead to numerous surgical applications, whether as regards the spot where we would introduce the knife for disarticulation of the leg, or in penetrating the joint when diseased, in order to form a diagnosis or prognosis of wounds of this region, or, lastly, to appreciate displacements and fractures. As in the elbow, the *skin* is thick, reddish, and more or less wrinkled over the middle eminence of the knee.

The *subcutaneous tissue*, abandoning the projections formed by the muscles of the thigh, gradually disembarrasses itself of its fat. Its lamellæ, approximating, condense, and terminate by almost blending with the aponeurosis. Thicker, internally, where it encloses the internal saphena vein, it merely forms a very thin membrane externally.

In front of the patella, its lamellæ constitute a *bursa mucosa*, frequently filled with blood or serum. The posterior wall of the cyst is then so firmly attached to the patella, that they are separated with great difficulty even by dissection. Thus, some surgeons are contented to remove all its free or anterior portion with the integuments. We may remark that, under these circumstances, the cicatrix is not always formed at the expense of the skin, that there are no granulations, but that the bottom of the wound becomes hard, dry, and, finally, constitutes a horny cicatrix.

The superficial position of the knee, and the continued friction to which it is exposed, render this bursa a most important part in surgery. Having the power of dilating and extending, abscesses and tumours sometimes acquire considerable magnitude. Its abscesses, being independent of the joint, may be opened largely, without risk, and stimulating fluids be injected, to produce adhesive inflammation. However, when it enlarges, its dissection, towards the sides, becomes both difficult and dangerous, as it quickly overlaps the patella or its ligaments. Lupia, in front of the knee, appertains to it, and is almost always the result of effusion of blood. When once transformed into a cyst, it is no longer sufficient to open nor even to excise it, but the whole must be removed.

Abscesses of this bursa may extend far into the cellular tissue of the thigh, or become dangerous by opening into the joint. Pushing the synovial membrane internally, it allows the bistouri to be introduced with less danger than might at first be imagined. The general symptoms accompanying these abscesses, the state of the skin, and the situation of the swelling, are sufficient to prevent their being confounded with those commencing in the articulation.

In consequence of the compact texture of the subcutaneous tissue over the patella and the condyles, wounds, with loss of substance, unite but badly by first intention. In infiltrations of the limb, or in fat individuals, these parts appear, as it were, buried, instead of projecting. The eminences of the

patella and condyles have, also, a tendency to protrude through corresponding wounds, interrupting cicatrisation in some individuals.

The aponeurosis, almost confounded with the ligaments, covers the whole joint. Thinner and, as it were, reduced to cellular membrane in the excavations above and beneath the patella, it is thicker externally than internally. Hence, in hydarthrosis, the synovial sac projects more particularly in the latter direction. Fixed over the condyles, it binds down the patella, its ligament, and the tendon of the extensor of the leg, but very loosely. Confounded with the external surface of the lateral ligaments, and continuous with the expansion of the tendons of the internal hamstring muscles, it forms a kind of capsule, sustaining the synovial membrane. In a word, the aponeurosis of the knee is a process of the fascia lata, the fibres of which, divided at some points, unite into bands at others, to accommodate themselves to the bony eminences and corresponding excavations.

Muscles.—The termination of the *triceps*, a portion of the *rectus femoris*, *adductor magnus*, and the expansion of the tendons of the *sartorius*, *gracilis*, *semi-tendinosus*, and *semi-membranosus*, and the commencement of the *popliteus*, are the only muscular dependencies found at the knee. The first, attached to the external condyle of the femur by a very strong tendon, separates the excavation, above the patella, from the corresponding femoro-condyloid fissure. Internally, the triceps appears to arise from the tendon of the adductor magnus. Its fibres, more numerous in that direction, also descend lower, consequently producing a more considerable projection. On both sides it is attached to the edges of the tendinous portion of the rectus, which becomes common to three portions of the triceps. Finally, applied over the anterior surface of the femur, drawing directly upon the patella, this tendon considerably increases the number of fleshy fibres, which, in their turn, endow the tendon with greater power, by preventing the possibility of its deviation from the median line. Notwithstanding its great strength, it may break from violent muscular action, as observed by Petit in three instances. Between the tendon of the rectus and the cruralis, there is a dilatable bursa, not communicating with the joint, but nearly always forming a complete cyst, in which we may have effusion, distinct from hydarthrosis.

The synovial membrane, extending considerably above the condyles, in effusions into the joint, the termination of the anterior muscles of the thigh is sometimes very much elevated, at the same time that the morbid projection overlaps the middle tendon, in the fossa above the patella. Hence, the dangers attending deep wounds above the patella, in front of the knee, and the reason of their differing, in this point of view, from those in the rest of the thigh.

The synovial capsule is strengthened by a very thick fibrous

expansion; the triceps also furnishes it with a small fleshy fasciculus, which may be considered as an extensor. The adhesion of this muscle to the femur is very weak; its fibres are united by cellular tissue, so supple, that matter formed in the articulation separates it, after having pierced the synovial membrane, and thus flows towards the middle of the thigh; whilst, on the other hand, inflammation may be primitively developed there, producing an abscess as large as difficult to be recognised, in consequence of its depth; which is, moreover, extremely dangerous, since it produces exfoliation, necrosis of the bone, and may penetrate the articulation.

Towards the leg, the tendon of the muscles of the thigh is prolonged as far as the tuberosity of the tibia, under the name of *ligamentum patellæ.* Rupture of this ligament has the same influence over the motions of the limb as transverse fractures of the patella, as upon it depends the whole action of the triceps upon the tibia. It is separated from the tibia by a bursa mucosa, smaller than that of the patella, and sometimes communicating with the joint. Abscesses, collections, and diseases of this bursa occasionally reach the joint above, and solid tumours formed in it are extremely dangerous and difficult to remove, in consequence of the ligamentum patellæ; so much so that, in 1833, in an operation of this kind, I was obliged to divide it in half.

The tendon of the adductor magnus, terminating on the internal tuberosity of the condyle of the femur, appears continuous with the internal lateral ligament of the joint, which is sufficient to prevent its being mistaken for those entering into the composition of the internal border of the ham. The tendons of the gracilis, semi-tendinosus, and sartorius enter very slightly into this region, where they spread out upon the tibia. The small bursa existing between their external surface and the skin, opposite the articular interstice, being liable to various transformations, and to become a tumour of some magnitude, shows how easily it might be mistaken for a *node*, and the fears which might attend its extirpation. I operated successfully twice, in 1831 and 1832; in one patient, it equalled the dimensions of a small egg, and was transformed into medullary tissue; in the other, it was as large as a walnut, and presented several cavities, filled with gelatinous matter. That of the popliteus is remarkable; in that, fixed, at first, behind the tuberosity of the condyle, it winds immediately behind the femoro-tibial articulation, and above the superior fibulo-tibial joint. Enveloped in a prolongation of the articular synovial membrane, and concealed by the external lateral ligament and tendon of the biceps, the popliteus muscle allows an instrument, placed at some lines below and behind the projection of the external condyle of the femur, to open into the cavity of the knee with facility.

Arteries.—Furnished by the superior and inferior articular

and tibial recurrent, the arteries of the knee, in their normal condition, are never sufficiently large for their division to cause alarming hemorrhage. After ligature of the popliteal, or even in aneurism of that trunk, they, on the contrary, frequently acquire considerable size. It is not, therefore, uncommon to see the anastomotic arch of the inferior and superior internal articular equal, and even surpass the volume of a crowquill. The same thing occurs, but less frequently, in the external branches, and they all form a rich and so complicated plexus, that operations, under these circumstances, require especial attention on the part of the surgeon. In 1822, I injected and dissected the limb of an individual whose popliteal artery Pelotin had tied forty-two years previously; it was the first operation, of this kind, performed in France. The articular arteries were in the state that I have described. If disarticulation of the limb should become necessary, under similar circumstances, we must expect to find numerous and large vessels.

Veins.—The saphena, the only one deserving of mention, lies between the integuments and the internal condyle of the femur, and may easily be compressed by external bodies, circulation being thus interrupted.

The *lymphatics* offer no peculiarity.

Nerves.—Some filaments of the obturator and crural arrive at the patella. The branch preserving the name of femoral, and leaving the artery before its passage across the adductor muscles, also descends, in the superficial layer of the triceps, as far as the front of the knee. Various filaments from the internal and external popliteal nerves equally supply this part; and, lastly, the saphena also traverses this region, in some individuals, although it more particularly appertains to the internal border of the ham.

Popliteal region.—Externally, *the ham*, to a certain degree, resembles the bend of the arm, but its excavations and eminences present themselves in an inversed order. Its inferior relief retracting, and rapidly lost in the *popliteal cavity*, is analogous to the bicipital eminence. The triangular excavation, occupying the centre, having its apex more or less prolonged in the posterior femoral region, very deep in semi-flexion, almost entirely disappears in extension of the limb. Its base seems to embrace the preceding eminence; and of its two margins, the external is formed by the biceps muscle or its tendon, whilst the internal is derived from the union of the sartorius, semi-tendinosus, gracilis, and semi-membranosus muscles. If we would extend the first, and make it project, we should bend the leg at the same time that the point of the foot is turned outwards. We render the other very prominent when, the limb being already semi-flexed, we endeavour to flex it still more, the heel being placed against a resistant body. We may then feel, beneath the skin, a fissure, separating the tendons of the gracilis and semi-tendinosus;

and this margin of the ham may be nearly two inches broad, whilst it almost entirely disappears in extension, or, at least, projects but very slightly over the posterior surface of the femur.

When extended, the borders of the ham may be divided transversely, without the artery being implicated, whilst in relaxation it would be quite the contrary. A ball or sword may also traverse them, and pass behind the femur, when the limb is bent; whilst the leg being extended, the vulnerant bodies would inevitably strike against the bone of the thigh. MM. Jobert, Ashmead, and Bourjot recommended the internal supra-condyloid fossa as the spot for exposing the popliteal artery in cases of aneurism. But attempts on the dead body have proved to me that the bone and tendons, between which the instrument must act, would render the operation more difficult and dangerous than in the popliteal cavity itself.

The *skin*, much more delicate and elastic than in front, is also much more extensible. It sometimes presents transverse wrinkles, but is much more frequently smooth, delicate, and bare.

The *subcutaneous tissue*, thin and more lamellous than in the thigh, is thicker and less compact than at the knee. The fat sometimes forms a very dense layer, and encloses all the elements capable of producing inflammation and abscess, which, when deep-seated, are exceedingly dangerous.

The *aponeurosis*, from the centre of the popliteal cavity, splits externally to envelope the biceps, and to unite, by its external portion, with the aponeurosis of the anterior region, whilst its internal layer is lost in the periosteum. Internally it also splits to form a canal for each of the muscles or tendons. Extending from the cutaneous surface of the external condyle, and from the head of the fibula, or, rather, from the margin of the biceps, it runs transversely to the posterior border of the expansion of the tendons of the sartorius, &c. and thus binds down the middle muscular eminence, or the commencement of the calf. Here its fibres interlace, or are oblique, but in the femoral portion of the region they are mostly transverse. Its deep lamellæ are so rarified in the popliteal excavation, that they mingle with the cellulo-fibrous tissue, enveloping the nerves and vessels. Although sufficiently strong to oppose a certain degree of resistance to the developement of aneurismal tumours, it is not sufficient to prevent the progress of these diseases for any length of time.

The muscles circumscribe a large lozenge-shaped space, which would be divided into two triangles by a line drawn transversely above the condyles of the femur. Of these the superior *femoral*, very large, is the proper popliteal cavity; the other, inferior, the *tibial*, smaller, separates the origin of the two gastrocnemii.

The biceps bounds the *femoral triangle* externally. The

fibres of its short head, running obliquely from the linea aspera to the tendon of its ischiatic portion, appear principally to be intended to increase the power of this muscle, by preventing its separation from the bone during flexion. Enveloped by aponeurosis, sliding over the posterior surface of the external condyle of the femur, before arriving at the head of the fibula, it is separated from the articulation by a fibrous layer, sufficiently thick to prevent its dragging upon the synovial membrane during its contractions.

Of the *four muscles* entering into the composition of the internal border of this space, the most superficial, proceeding from within outwards, is the sartorius, which remains fleshy as far as the condyle of the femur. Its tendon, thrown inwards and backwards by this prominence, before spreading out on the internal surface of the tibia, acts there as upon a pulley, and so adducts the limb, at the same time that it flexes it. The *gracilis*, almost entirely reduced to its tendon, approximates the thighs, always favouring flexion of the limb.

The *semi-tendinosus* projects most backwards, because, arising from the ischium superiorly, it descends upon the tibia lower than the others, and is very far from the femur when the limb is flexed. Whilst the two others, being inserted superiorly on a plane, anterior to this bone, cannot be so much separated from it. It, moreover, draws the point of the foot very strongly inwards.

The *semi-membranosus*, the largest, strongest, and most deeply seated, is external to the others, and nearer the femur. Forming the internal wall of the popliteal cavity, without being always attached to the internal branch of the inferior bifurcation of the linea aspera, otherwise than by its investing aponeurosis, it establishes a difference between the two borders of the ham, inasmuch as the short portion of the biceps is attached immediately on the bone. Passing behind, and internal to the internal condyle of the femur, to attach itself to the corresponding tuberosity of the tibia, it is the nearest to the articulation, which it moreover strengthens, by sending a fibrous expansion over its posterior surface, which, with the ligament of that articulation, appears destined to keep the synovial membrane separated from the cartilaginous surfaces during flexion of the limb.

The *inferior* or *tibial triangle* is formed by the separation of the *gastrocnemii*. Attached above the condyles, and bounded by the tendon of the biceps externally, and semi-membranosus internally, bending over the posterior femoral eminences as over a pulley, during extension of the limb, these muscles constantly tend, in fractures of the inferior fifth of the femur, to draw the portion upon which they are attached backwards; hence, flexion of the limb is the only position by which we may insure exact apposition.

The *plantaris*, remarkable for its smallness, would not merit

any notice, if, in running from the superior portion of the external condyle, in front of the internal portion of the gastrocnemius to the leg, it did not cross the popliteal vessels and nerves, compressing them in forced extension of the limb.

The *popliteus* winds from without and above, inwards and downwards, behind the articulation, which it crosses, and against which it is applied. Covered by a layer continuous with the fibrous elements of the articulation above, and making part of the deep aponeurotic expansion of the leg below, it is thus bound down to the posterior surface of the bone. The synovial membrane investing its tendon, sometimes continuous as far as the head of the fibula, amputation of the leg, through the condyles of the tibia, may become extremely dangerous. Lastly, the apex of the soleus, mounting to beneath the head of the fibula, lies also in this region, where we meet with its aponeurotic arch. Much more like that of the diaphragm than that traversing the femoral artery, at its entrance in the popliteal region, this arch depends on a fibrous band, which passes behind the vessels and nerves, uniting the fibular and tibial portions of the muscle.

Arteries.—The *popliteal*, the continuation of the femoral, extends from the opening in the adductors to the arch of the soleus. Oblique from within outwards, it is superiorly at the inner side of the ham, whilst, below, we meet it nearer the external side. Being in relation with the posterior surface of the adductor magnus, femur, articulation or ligament closing it, and popliteus muscle; being, generally, only separated from these parts by a thin layer of cellular tissue or fat, it is necessary, that in traversing the joint we take the greatest precautions to avoid it. It may, on emergency, be compressed against the femur in the popliteal cavity. Its adherence to the vein being more intimate than in the thigh, this latter, unless great care is taken, may easily be wounded by the aneurism needle, in passing a ligature round the former. More posteriorly, and a little externally, we find the internal popliteal nerve; subsequently, cellular lamellæ, fat, and aponeurosis. Internally, it at first runs immediately close to, subsequently at a great distance from, the external surface of the semi-membranosus muscle, as far as the internal condyle; and contracts, externally, the same relations with the biceps muscle. It is concealed between the condyles by the popliteal nerve and vein posteriorly, and by the gastrocnemii muscles on each side. Crossed by the plantaris before entering the fibrous arch of the soleus, enveloped by lymphatic glands, fat, and cellular tissue, it would be difficult to expose it at this point, unless, according to the method of M. Moreau, by cutting over the part separating the fissure of the calf from the internal border of the ham, and pushing the superior extremity of the internal gastrocnemius outwards or backwards. Its bifurcation, opposite the condyles of the femur, as I have twice seen,

or higher, as mentioned by Sandifort, Portel, Ramsay, is the only anomaly, worthy of attention, which has been presented by the popliteal artery, up to the present time.

Several authors have thought to account for the frequency of popliteal aneurism, by the relations of the artery with the bone. Richerand, for example, maintains that this vessel may be ruptured in violent and sudden extension, the articulation then projecting backwards; we may add, because the artery is, at the same time, stretched by its two extremities, each engaged in a fibrous opening. Others have affirmed that, in the dead body, the most violent extension never produces any thing of the kind, and Scarpa finds the reason of aneurism in alteration or disease of the tunics of the vessel; but it appears to me, that neither of these explanations militates against the other. In the tibial portion of the artery, the resistance of the condyles and gastrocnemii muscles, as well as the aponeurosis, forces the aneurism towards the thigh. Superiorly, on the contrary, the semi-membranosus and biceps muscles force it to descend; consequently, when the tumour acquires any size, it occupies the centre of the popliteal space, although the perforation of the artery may exist superiorly or inferiorly, as well as in the middle of the region.

Pressed by the aponeurosis, which is very strong, posteriorly, and by the muscles, which are not less so, on the sides, this tumour, re-acting against the posterior large and spongy portion of the femur, causes absorption of the bone, so that we not unfrequently observe the knee broken and destroyed, in consequence of aneurism in the cavity of the ham. We have also an example of the efforts exercised by the femoral artery in the motion which it gives to the limb, when we hold the popliteal region semi-flexed upon the knee of the opposite side.

The *superior articular* arise, the external from the popliteal, immediately it receives that name, or even from the femoral, during its passage between the adductors; the internal, above the corresponding condyle; and the middle, behind the joint. A ligature, therefore, may be easily placed between them. Moreover, being in general small, they can scarcely prevent the formation of a coagulum above the point obliterated by the thread. The first, running principally to the short portion of the biceps and vastus externus, is the most superficial. The second, winding above the condyle, between the semi-membranosus and tendon of the adductor magnus muscle, to arrive at the knee, and in the vastus internus, is more deeply seated, in consequence of its being closer to the bone. The third, perpendicularly traversing the posterior ligament of the articulation, and distributed to the synovial membrane, cellular tissue, and all the fibrous portions of the articulation, is still more easily reached.

The *inferior articular* and *muscular* leave the trunk below the inter-condyloid notch, to wind beneath the eminence of the tibia,

between that bone and the lateral ligaments of the articulation, and terminate in the two gastrocnemii muscles. The numerous and free anastomoses, formed by the various branches, explain the re-establishment of the circulation in the limb, when we apply a thread on the popliteal artery, between their roots; between the first and second, for example. Their communications with the perforating also account for the return of pulsation in the aneurism, when the ligature is placed on the femoral above the adductor magnus.

The other branches of the popliteal are too small and irregular to merit any attention. We will, therefore, only remark, that the anastomotica magna, which has already been described in the femoral region, descends as far as the internal condyle of the femur, parallel to the tendon of the adductor magnus; and that, frequently situated in the substance of the tendon, it is sometimes difficult to tie or twist it after amputations.

Veins.—The *external saphena*, gliding between the layers of the aponeurosis, from below and behind, forwards and upwards, to open into the popliteal, above the condyles of the femur, is not compressed by the garters; whilst the internal is equally constricted, whether we place them above or below the knee. It only interferes in the ligature of the artery, in the inferior triangle of the popliteal space; but such is its size there, that we should preserve it, and not cut too much externally.

The *deep veins*, disposed like the arteries, are all rather more superficial. The popliteal, placed directly behind, in traversing the adductor muscles, inclines slightly outwards in the superior triangle of the region. Placed posteriorly, opposite the articulation, and lying below quite internally, it admits of the artery being seized, almost indifferently, by its internal or external side, when it is above or in the condyloid notch; whilst, behind the femur, we should attack it only on its external side; and its internal, when immediately above the soleus muscle. Their union is, besides, sufficiently intimate to require some precaution in separating them, as, although supple, and mingled with fat, the sheath enveloping them is very resistant.

The *lymphatics.*—The superficial layer is in no way remarkable, but in the deep we find a certain number of glands worthy of attention. Four or five in number, they surround the trunks of the vessels; one is internal, another external, a third between the artery and the femur, and a fourth behind. In consequence of this disposition (although not constant), if they become enlarged they may compress the vein or artery, producing infiltration or numbness of the limb. As it were, attached to the vessels, they receive the impulses from the arteries, and are liable to be mistaken for aneurism, which may itself cause the swelling; thus rendering the surface of the sac knobby.

The *popliteal nerves*, arising from the bifurcation of the

sciatic, are both external to the artery, and diverge as they descend.

The *external*, insensibly approaching the internal surface of the biceps, enlarges and flattens external to the condyle of the tibia, and quickly passes beneath and behind the head of the fibula. Winding round it towards the front of the leg, this branch has the muscles of the calf to its inner side. Being subcutaneous between the external head of the gastrocnemius, the biceps, and peroneus longus, it is there that we should place the blister recommended by Cotugno in sciatic neuralgia, and remove a portion of the nerve. The musculo-cutaneous nerve detaches itself at one or two inches above the external condyle of the femur, and ramifies between the layers of the aponeurosis, as far as the posterior and external surface of the calf.

The *internal popliteal nerve*, the continuation of the great sciatic, descends parallel to the axis of the limb. Placed on the external side of the vein, it crosses its posterior surface very obliquely, getting internal to it beneath the condyles of the femur. Of the three important organs of the popliteal cavity, this is nearest the skin. It gives off a branch, sometimes higher, sometimes lower, but always above the condyles, and which quickly reaches the calf, being the principal root of the external saphena nerve. Before entering beneath the soleus muscle, it gives off another branch of a certain size, which follows the posterior surface of the artery, and would be avoided with difficulty, when we are obliged to tie this vessel quite low down.

M. Thomson informed me, that he traced a branch of the obturator nerve as far as the popliteal space, penetrating the articulation. As this nerve, at the same time, supplies the articulation of the hip-joint, we there find a very reasonable explanation of the pains experienced in the knee by persons affected with diseased hip-joints.

The mass of cellulo-adipose tissue being here blended with lymphatic glands, blood-vessels, and nerves, abscesses form with great rapidity, and promptly become dangerous. The pus, retained by the aponeurosis posteriorly, and, on each side, by the tendon of the muscles, we cannot feel fluctuation until a very late period. The thick layer, extending as far as the ischium, enveloping the sciatic nerve, favours their fusion towards the thigh, in the same way as its prolongation towards the calf, in some measure, draws them in that direction. In a young man, who came to the Hôpital de la Faculté in 1825, the abscess was so large that more than a quart of pus was discharged the first day. A second subject, admitted under my care, at the Hôpital de la Pitié, in 1830, had a still greater discharge, although there was scarcely any external projection. The solidity of the walls of these abscesses renders cicatrization very difficult. Having destroyed or altered the cellular tissue, they may, in closing, cause a contraction of the cavity, and a state of forced

flexion of the limb, as in the retractions in consequence of burns. It is, therefore, important, that we should open them as early as possible, and not allow their extension in any direction.

The *skeleton* of the knee comprehends the patella, the inferior extremity of the femur, and the superior portions of the tibia and fibula; we may also add the numerous ligaments uniting these parts.

The *patella*, which, to a great degree, resembles the olecranon, at least as to its functions, differs from that process by its mobility, and by its union to the tibia. Developed in the substance of the extensor tendon, at two or three inches above the tuberosity of the tibia, it divides this tendon, so that it forms below the ligamentum patellæ. Preserving its relations with the bone of the leg, in the various motions of the joint, the patella is placed beneath the condyles of the femur in complete flexion, whilst, in extension, it mounts very high, even above the articulating surface. In the former case its posterior surface, habitually divided perpendicularly into two, and sometimes even three cartilaginous facettes, buries itself between the surfaces of the condyles, which are so large, transversely, that all displacement would thus be rendered impossible, even if tension of the muscles did not prevent it. But this is not the case in its fracture; in fact, lying, by its angular surface, on the inferior portion of the inter-condyloid fissure, we can conceive, that a fall on the knee, joined to violent contraction, to maintain the trunk, may determine transverse division. In the second case, on the contrary, fractures, almost impossible by muscular action alone, are rarely produced by a direct cause, in consequence of the greater mobility of the bone. Luxations in this position appear, at first, to be very easy, when, in reality, they are very uncommon. Although more elevated internally than externally, it is, nevertheless, more frequently dislocated in the former than latter direction; the reason for this being the anatomical relation of the parts. Its internal border, projecting further than the external, exposes it more to the action of external bodies.

The anterior facette of the internal condyle of the femur, more elevated and longer than that of the external, also renders displacement more difficult in this direction. The crest, separating the posterior surface into two, being nearer the external than internal border, it is more easily luxated externally. In many individuals one of the knees is so much turned towards the other, that a line, drawn from the antero-inferior spine of the pelvis to the tuberosity of the tibia would pass external to the patella. As its inferior ligament is, at the same time, oblique outwards and downwards, it is evident that, whether during flexion or in any other position, the muscles must tend strongly to draw the patella in this direction.

Thus, not only may muscular action assist external luxation

of the patella, when pushed by a blow or any effort, but it may produce it alone. This is the explanation of many spontaneous luxations, which, on the other hand, appear also to depend on relaxation of the ligamentum patellæ, as related by Itard and M. J. Guerin; or by narrowness of the articular surfaces, as observed by Boyer; or from any other anomaly. The almost constant luxation of the patella in paralytic persons, and the rarity of these displacements internally, depend upon these united peculiarities, and not on one alone. When once luxated externally, the patella, it is true, deprives the extensor muscles of the leg of a great portion of their action, by approximating them to the axis of the limb, from which they are very far separated in the natural state. But they do not, on that account, become flexors, neither do they cause that condition of exaggerated flexion of the knee, in certain patients, as observed by Beclard.

If, in transverse fracture of the patella, the fibrous expansion enveloping it is torn at the same time, the superior portion may be so drawn up, that exact and permanent apposition, during the period necessary for the formation of callus, is almost impossible. Thus Pibrac defied anybody to show him a fracture of the patella united without intermediate fibrous substance. The modern authors have also admitted that this bone does not allow of any other method of union; but Lallement considered that he proved union by true callus possible. Whatever this interposed substance be, it gives as much power to the patella as immediate union, when the separation is not carried beyond an inch, and, therefore, it appears useless to torture the patient to obtain any other result. Although the fragments are with difficulty maintained in contact in transverse fracture, this is easy when the patella is divided parallel to the axis of the limb. In fact, the muscular contractions tend much rather to approximate the bones than to divide them. As they can only be produced by a direct cause, we should keep the limb extended and immobile, if we would obtain a quick and sure consolidation.

A wound, which would comprehend the whole thickness of the rectus muscle, would render extension of the leg almost impossible; for, although the two lateral portions of the triceps pass over the sides of the knee, they can only act upon the tibia through the intervention of the patella. Since the action of the muscles sometimes fractures the patella, it is by no means surprising that it should also rupture the ligamentum patellæ. It is, moreover, remarkable, that if these ruptures, whether osseous or fibrous, are not consolidated, they do not always destroy the functions of the limb. An old officer of the marines, and a patient entered at the Hôpital de la Pitié, in 1832, having a separation of more than three inches between the two

portions of the patella, which had been fractured a long time previously, were not much inconvenienced in walking.

The *femur* is remarkable here for its size, the disposition of its condyles, and its spongy texture. Fractures are rare; but when they do occur, the lower portion, being unsustained by the muscles of the thigh, is drawn backwards by those of the leg. If the fracture is very oblique from the body of the bone towards the articulation, one of the condyles may be completely separated, as remarked by Delpech, and as I saw in 1833. The internal, the longest and thinnest, is naturally more exposed to this accident than the other. I have, however, in a man aged sixty, seen the anterior border of the external fractured at the same time as the patella, of which it appeared to form a third fragment. When we reflect upon their transverse diameter, we soon arrive at the conviction that complete luxation, in this direction, is impossible, without frightful mischief. I have already demonstrated, that, in the antero-posterior direction, these displacements are, on the contrary, very easy.

The *tibia* here presents its tuberosity, which, as we know, serves as a limit in amputations of the leg. The ligamentum patellæ, adhering to the bone, nearly an inch above, admits of the operation being performed a little higher.

The *head of the fibula*, easily felt, immoveable at about an inch and a half below the external condyle, merits no attention in surgery, excepting as regards amputations very close to the knee. Under these circumstances, it may be asked, whether, being jarred by the saw, and moved at each dressing, it may not produce serious inconvenience, and whether it would not be safer to remove it in the first instance?

The *synovial membrane*, investing these various portions, is the most extensive of all. It is pushed towards the interior of the articulation by a kind of adipose cushion, in which the lamellæ assemble into a small ligament, running to be attached between the condyles. This ligament, named *adipose*, enveloped by the synovial membrane, which it appears to divide in two, causes the fluid to tend towards the sides of the patella in hydarthrosis. The synovial membrane, prolonged in a cul-de-sac beneath the triceps, also reflected a considerable distance over edges of the cartilaginous surfaces of the femur, and over the contour of the condyles of the tibia, is sustained, externally, by the lateral ligaments and the fibrous expansions which have already been described with the aponeurosis. The points corresponding to the two fossæ above and below the patella, as well as to the lateral fissures, being extensible and very supple, are the spots where it projects most when distended by fluid; indicating that we should carefully cover these with graduated compresses, if we would apply exact compression around the knee. As it sometimes extends as far as from three to four inches above the

patella, or, rather, as far as the tuberosity of the tibia, and even below the head of the fibula, it also accounts for the danger attending some wounds and tumours, which would otherwise be difficult to explain. Posteriorly, the skeleton, merely comprising the back of the articulation, is composed of the triangular surface of the femur, of a similar surface appertaining to the tibia, and of the posterior portion of the condyles, with the notch separating them; on which account, when the limb is not bent, an instrument would divide the vessels long before it traversed the articulation from before backwards.

The posterior ligament, and the origins of the gastrocnemii, so complete the joint behind, that effusions of the knee scarcely ever project in that direction, whilst they rarely fail in being announced by a more or less marked relief on either side of the patella, or its ligaments.

Hence, we remark, that there are but few soft parts surrounding the knee, and that amputation is consequently very easy. The argument invoked by Brasdor and myself in 1826, against this operation, and which I have since endeavoured to re-establish, appears, on the contrary, to plead strongly in its favour, when we consider the subject with more attention. The size and regularity of the bony surfaces form a perfect support for the artificial limb. The integuments alone requiring to be preserved, the wound is, in reality, of but little extent; whence we have less re-action to dread. Cut before its bifurcation, the popliteal artery is easily twisted or compressed. The circular method which I have proposed allowing merely of a small portion of the muscles being left behind, the suppuration and inflammation of the stump are less serious than after amputation above the knee. The whole thigh being preserved, the patient walks as after amputation of some portion of the leg. There is, in fact, only the large cul-de-sac of the synovial cavity, above the articulating surface of the femur, which, by inflaming, can render this operation dangerous.

SECTION FOURTH.

OF THE LEG.

Situated between the knee and the malleoli, the leg resembles the fore-arm, from which it differs merely as regards some peculiarities connected with its functions. Forming an irregular cone, with its largest extremity turned upwards, it presents, anteriorly, on the median line, the crest of the tibia, extending from the tuberosity downwards, becoming gradually rounded. Externally we see an inclined plane, corresponding to the dorsal muscles, and, posteriorly, a considerable eminence, broad and very convex superiorly, where it constitutes the calf, and

tracting as it descends, forming a kind of cord representing the tendo Achillis. In contraction the calf is separated into two portions, by a double fissure, corresponding to the point of division of the gastrocnemii and solei muscles. Externally it is confounded with the anterior plane, from which it is separated by a gutter, at first but indistinct, marking the interval between the solei and peronei, and, subsequently, between the tendo Achillis and fibula. Internally another gutter isolates the calf or tendo Achillis from the tibia, through the whole length of the leg. Superiorly the cellulo-adipose space being bounded by the internal margin of the tibia, and the corresponding head of the gastrocnemius, caustics, issues, &c. are better placed here than elsewhere.

The conical form of the leg renders compression, by means of a bandage, very difficult. The contraction of the gastrocnemii, especially during walking, rarely fails in separating the turns of the bandage below, causing the lower ones to overlap each other, producing constriction, irritation, and excoriation of the skin above the malleoli. The mass of soft parts constituted by the calf preventing compression, if we would obtain a regular effect of the bandage, in erysipelas phlegmonoides, for example, we should cover this part of the leg with graduated compresses. The same thing is also necessary in front, in consequence of the crest of the tibia, which, receiving all the action of the roller, naturally tends to cut the skin. Bandages of sticking-plaster do not generally require these precautions.

The *anterior* or *external region* comprehends the collection of soft parts reposing on the inter-osseous fossa. Larger superiorly, and especially in the centre, where it is convex, than below, where it is rounded, and confounded with the internal surface, this region offers (in extension only) various eminences and depressions produced by the muscles.

The skin, generally covered with a quantity of hair in man, and of a dense texture, enjoys sufficient mobility to admit of wounds, with a certain loss of substance, uniting by first intention. Not being very extensible, abscesses, tumours, &c. have great difficulty in projecting externally, in front of the limb, and, consequently, for the most part remain flattened.

The *superficial layer*, disposed as on the back of the fore-arm, generally very thick, is easily dissected in amputations. Placed between two solid layers, the aponeurosis, and skin, it easily inflames, and may become the seat of extensive inflammation and abscess. The pus, then spreading with rapidity in all directions, particularly upwards and downwards, indicates the necessity of their being opened as *early as possible*, to prevent destruction of the skin. As there are neither vessels nor nerves of any importance, we may make numerous incisions without any danger.

The *aponeurosis* is strong, very distinct, and tense. Its fibres

are principally oblique from above downwards, from the fibula towards the tibia. In its superior fifth it gives attachment to muscular fibres. Below, it is pierced by the anterior tibial and musculo-cutaneous nerves. Passing from the crest of the tibia, which serves as an attachment, internally, towards the external portion of the region, it gives off no septum between the muscles, but receives the intermuscular cellular tissue, which becomes united to its posterior surface. Attached over the anterior margin of the fibula, binding down the dorsal muscles, and separating them from the peronei, it passes over these latter, and is inserted on the posterior border of the same bone, forming their sheath, dividing them from the soleus. In consequence of its strength and inelasticity, it prevents swelling in deep-seated inflammation, and we are, consequently, obliged to divide it *early*, or to prolong the incisions where the inflammation manifests itself, in consequence of a wound.

The *muscles* are here of two classes; the one anterior, the other external. The former, the tibialis anticus, extensor communis, the extensor proprius pollicis, concealed between the two preceding, subsequently the peroneus tertius, which not always exists, and may be considered as the external fasciculus of the common extensor, situated between the tibia and fibula, are, as it were, bound down in a canal, formed, posteriorly, by the external surface of the tibia and anterior portions of the inter-osseous ligament and fibula; in front, by the aponeurosis.

The *tibialis anticus*, the largest, prismatic, is separated from the extensor communis and extensor proprius by a cellulo-adipose septum, which should be borne in mind when we tie the anterior tibial artery. The others offer scarcely any interest in surgery. Those of the second class, or the external muscles, enveloped in their fibrous canal, applied, for some extent, on the external surface of the fibula, terminate by entering the posterior region of the leg. Completely separated from the extensors, and from all the muscles of the posterior region, by the two aponeurotic septa, attached to the anterior and posterior margins of the bone, they act independently. The adherence of the muscular fibres continuing until just above the external malleolus, a transverse section in the two superior thirds does not destroy their action on the foot, whilst, lower down, it would render abduction almost impossible.

Arteries.—The *anterior tibial*, alone meriting any attention, is the first branch furnished by the popliteal, after traversing the fibrous arch of the soleus. Arrived between the common extensor and the tibialis anticus, it descends to that portion of the region parallel to the line indicating the muscular interstice. It appears to ride over the commencement of the inter-osseous ligament. This angular curve, scarcely noticed by anatomists, has caught the attention of M. Ribes, who thus explains the very great retraction of the anterior tibial artery after amputa-

tion of the leg. It runs between two veins, through its whole course. The nerve is to its external side above; in front, in the middle; and internal, below. An extensible, but resistant, cellular sheath unites the whole. Thus, it is not always easy to isolate it completely, and to comprehend it solely in the ligature. To expose it we are obliged to penetrate deeper, when we operate at its upper portion. It was subcutaneous in a patient mentioned by Pelletan, and was absolutely wanting in a subject dissected by Huguier. A large branch of the peroneal, which had traversed the inter-osseous ligament, at about two inches above the joint, supplied the place of its lower portion in the latter case.

The arterial branches, given off by the anterior tibial, are merely muscular; very numerous, it is true, but very small. The recurrent, ascending over the outer side of the patella, is the only one meriting any special mention, and has already been described.

The *veins*.—The subcutaneous layer only enclosing very small ones, varices but rarely occur on the anterior region, although they sometimes are developed, and ulcers are not unfrequent. They are chiefly branches of the external saphena, with a few from the internal. The deep-seated, two in number, accompany the artery, and are rather anterior. Being themselves covered by the nerve, it is always very difficult to avoid implicating them in the ligature of the artery.

Lymphatics.—The superficial, formed by eight or ten principal trunks receiving part of those from the sole and dorsum of the foot, passing, internal to the knee, to the superficial glands of the groin, subcutaneous inflammations of the inferior extremity are referred to the tibial region, whilst those of the latter re-act on the inguinal glands.

The deep-seated, following the course of the blood-vessels, deep-seated disease of the front of the leg may produce alteration of the glands of the ham. A lymphatic gland, which I have seen transformed into a tumour as large as an egg, lies habitually in front of the anterior tibial vessels, sometimes higher, sometimes lower; but always beneath the opening in the interosseous ligament, which gives them entrance to the popliteal cavity.

Nerves.—The external popliteal furnishes all, but by two different branches, beneath the head of the fibula. The *musculo-cutaneous* descends with the peroneal muscles, crosses them obliquely from behind forwards, and becomes subcutaneous at three or four inches above the instep, where it divides into two branches. Having wound over the external and anterior surfaces of the fibula, behind the origin of the peroneus longus and extensor communis, the second branch, or tibialis anticus, places itself on the external side of the vessels, insensibly approaching them as it descends, and crossing their anterior surface, to run along their inner side before arriving below.

The *posterior region* of the leg, comprising the mass of soft parts found behind the bones, encloses the double eminence of the calf, that of the tendo Achillis, and the tibio and peroneo-calcaneal fissures. In man it is habitually more uneven and *withered* (sèche), in proportion, than in woman, the cellular tissue being more abundant in the latter.

The *skin* more delicate, covered by fewer hairs than on the anterior region, tumours and collections of all kinds raise it with greater facility; whilst, in operations, we may remove a large portion, and wounds, whether in the course of the limb or transverse, more easily unite by first intention.

The *subcutaneous tissue*, disposed as over the palmar surface of the fore-arm, lamellous rather than filamentous, adhering but slightly either to the aponeurosis or skin, is predisposed to the diffusion of inflammations.

The *aponeurosis* is a continuation of that of the ham. We may consider it as formed of two principal layers; one superficial, the other deep. Attached to the posterior border of the fibula externally, and on the inner margin of the tibia internally, the first appears to arrive particularly from the expansion of the tendons of the sartorius, gracilis, and semi-tendinosus. Applied over the posterior surface of the calf, it is lost below in the fibro-cellular tissue surrounding the heel. Enjoying a certain degree of elasticity, it allows deep-seated abscesses to become superficial with great facility. The second layer is a continuation of the aponeurosis of the popliteal cavity, and descends between the two layers of muscles; but splitting into two at the point where the soleus detaches itself from the deep parts, one of its divisions follows the anterior surface of the tendo Achillis, of which it completes the fibrous canal, formed posteriorly by the superficial layer, the other remains applied over the posterior surface of the deep muscles, and both arrive at the heel.

In its inferior third, the aponeurosis of the leg thus circumscribes three spaces. One is filled by the tendon of the muscles of the calf. The second encloses the flexor muscles of the toes and the vessels. The third, which separates the two others, lies between the tendo Achillis and the posterior surface of the last-named muscles. The latter is remarkable from being filled with fat and fibrous filaments, interlaced in various directions. Four species of pathological collections may, therefore, occur here; three in the three sheaths just mentioned, and the fourth in the subcutaneous tissue.

The *muscles* form two distinct layers. In one, the gastrocnemii and the soleus, at first separated by a cellular layer, ultimately unite in a single tendon. The former terminate above the middle of the leg, the latter continues to descend alone to the inferior third of the limb. Taking its point of insertion on the posterior surface of the tibia below the popliteus muscle, and upon that of the fibula beneath the head

of that bone, it is so disposed, that to expose the posterior tibial artery, we must divide its internal portion, and the fibrous membrane upon which it is inserted. The power of the muscles of the calf is such, that they have, in more than one instance, been observed to rupture the tendo Achillis, in a violent effort to avoid falling.

The portion appertaining to the gastrocnemii, at first thin and broad, contracts and thickens in the same proportion before blending in an intimate manner, at about three inches above the malleoli, with that of the soleus, which is much larger and stronger. We also perceive, that if it be easy to comprehend the possibility of an isolated rupture of the tendon of the gastrocnemii, before its union with that of the soleus, as occurred at the Hôpital de la Pitié, in 1832, we should at least allow, that the observations of Petit, De la Motte, &c. are far from demonstrating its existence, which has never hitherto been proved in the dead body. The third portion is merely the tendon of the plantaris, descending obliquely inwards on the anterior surface of the gastrocnemii, to accompany the internal border of the tendo Achillis. Although thin and remarkably long, its power and resistance are such, that it is not so easy to comprehend its rupture, as appears to be generally supposed. In fact, authors on animal mechanism have remarked, that it may support a weight of five hundred pounds. Nevertheless, the contractions of the only muscle which can act upon it are certainly insufficient to raise such a weight.

As the fleshy fibres of the soleus descend as far as the heel, the complete rupture of the tendo Achillis can scarcely occur, excepting quite low down. It is then necessary, according to authors, to fill the tibio and peroneo-calcaneal gutters with compresses or any thing else, at the same time that we flex the knee and strongly elevate the heel; but in forced extension of the latter, the aponeurosis, drawing the tendo Achillis against the posterior surface of the deep muscles, renders these compresses useless. A simple bandage gives the same results, whether there be or be not lateral pressure. This tendon is so prominent behind, that a sharp instrument may divide it completely, without touching either the vessels or principal veins. Union must then be obtained as in simple rupture.

As the retraction of the tendo Achillis appears to be the cause of the deformity termed *club-foot*, it has been proposed to divide it, subsequently separating its two extremities by keeping the point of the foot raised. This operation, which M. Bouvier has frequently practised with success, by merely making a simple puncture in the skin, should be performed opposite the base of the malleoli; lower down, the heel would prevent its succeeding, and more superiorly the tendon is not sufficiently free.

The deep muscles, bound down in the posterior inter-osseous fossa, by the inter-muscular layer of the aponeurosis, are, first,

the tibialis posticus, upon the posterior surface of which lie the tibial vessels and nerves; secondly, the flexor proprius pollicis; and, thirdly, the flexor communis, rather deeper seated than the two others, and covered by a fibrous layer, which mingles as it descends with the deep aponeurosis. The space containing them diminishing in breadth towards its inferior portion, they are forced to approximate as they arrive near the internal malleolus.

The *arteries* are given off by the termination of the popliteal. The anterior tibial traverses the inter-osseous ligament, after a course of some lines. Occasionally separating from the trunk, before it enters beneath the arch of the soleus muscle, it most commonly arises beneath the popliteus. In which case, if amputation of the leg were performed very high, we might have only one arterial trunk to tie. Having furnished the *anterior tibial*, the popliteal sometimes descends an inch lower before it bifurcates. It is then upon the anterior surface of the aponeurotic origin of the soleus. The nutritious artery of the tibia, also arising in this course, we should have, at least, three ligatures to apply, after a transverse section of the limb, opposite the inferior margin of the popliteus; one on the popliteal, another on the anterior tibial, and a third on the nutritious artery of the bone. Up to this point, the nerve is internal to the artery, as it were, enveloped by its two collateral veins. Of its two terminating branches, the *posterior tibial*, the largest and most important, appears to be the continuation of the original trunk.

Passing towards the internal border of the tibia, this branch follows a very slightly oblique direction. It corresponds at first to the middle of the inter-osseous space; subsequently by degrees, to the point of union of the common flexors, and the tibialis posticus; finally, to the posterior surface of the latter. The two accompanying veins are placed behind, without adhering very solidly. Its ligature, therefore, must present differences in the two principal points where we can operate. Towards the union of the superior with the middle third of the limb, we reach it without difficulty. The important point consists in falling on the deep aponeurosis, which we find with certainty by carefully dividing the tibial portion of the soleus muscle, in the direction of a line extending from the skin towards the external border of the tibia. But it appears, that in the living subject, if the patient be strong, the muscles of the calf contract violently, and may prevent their separation. Hence M. Bouchet de Lyon was forced, in a case of this nature, to cut the posterior lip of the wound across.

In the inferior third of the region, and at about two or three inches above the internal malleolus, we cut on the middle of the space separating the inner border of the tibia from the tendo Achillis. We then meet with skin, subcutaneous tissue, subsequently the posterior portion of the aponeurosis, before

entering the cellulo-adipose layer, separating the tendo Achillis from the deep muscles. The fascia binding these last being divided, the artery is found in the interval between the tibialis posticus internally, the flexor proprius pollicis externally, and the flexor communis, upon which it lies. The collateral veins sometimes completely conceal it. If we cut too near the tendo Achillis, we open the sheath enclosing it, and lose ourselves in the cellular tissue, without finding the artery; too near the tibia, we meet with only fibrous membrane before reaching the muscles, and become bewildered among them. It is evident that in endeavouring to attain the artery, by dividing the muscles of the calf directly from behind forwards, as recommended by Mr. Guthrie, the difficulties would be still greater than by the above method.

The second terminating branch of the popliteal, or the *peroneal*, slightly separates from the preceding, and descends, applied on the posterior surface of the fibula, between the flexor proprius pollicis and flexor communis. It is so small and deeply seated, that its wounds are rare and unimportant. Hence, but little has been said of its ligature, which would be very difficult, and could only be performed at the middle of the external side of the leg. We should then divide the same parts as for the tibial, but on the opposite side; and as it is enveloped in the fibres of the flexor proprius pollicis, we must also detach it from the fibula. Below, it is too small and too deeply seated for its ligature ever to have been attempted.

The *gastrocnemii* are also two branches which must be observed in the posterior region of the leg, as they frequently require a ligature after amputations.

The *superficial veins* are the most important here. In no other region of the body do they offer more surgical interest, on account of their number, size, and the diseases attacking them. However, they all pass to the trunks of the two saphena veins, of which the internal enters this region at some inches above the malleolus. Following the external border of the calf, it traverses the superior constriction of the leg, to arrive at the knee precisely in the fossa, where issues are commonly applied. Receiving a great many branches, being very far from the heart, and continually forced to strive against the laws of hydraulics, from its depending position, there is nothing surprising, that, of all the veins of the body, it is most frequently affected by varices, notwithstanding the number of its valves.

The *external saphena*, running along the whole of the region, mounts obliquely and tortuously, from the peroneo-calcaneal gutter, over the posterior surface of the external gastrocnemius, to bury itself in the ham. At first, enveloped, like the preceding, in the subcutaneous tissue, it immediately enters between the layers of the aponeurosis, so that, superiorly, its depth shelters it from the compression of the garters, which, added to the less

volume of blood, partly explains why it is more rarely the seat of varices than the internal. Accompanied, moreover, like the latter, by a large nerve, it presents the same surgical considerations in its inferior third. As we occasionally perform phlebotomy upon it in the malleolar gutter, we must remark, that there especially the nerve is very close to it; but that, on the other hand, we have no other organ to preserve. The deep veins have been described in speaking of the arteries, which they everywhere follow.

The superficial lymphatics, very numerous, receive all the branches from the sole of the foot, and arrive at the inner side of the thigh after having traversed the popliteal space. The deep-seated accompany the blood vessels, and pass to the glands of the ham. Hence, diseases of the subcutaneous cellular tissue re-act upon the inguinal glands, whilst those occurring beneath the aponeurosis exert their influence on the glands of the popliteal space.

Like the veins and lymphatics, the *nerves* are superficial and deep. The two saphenas belong to the first class. The external, arising by two roots from the two popliteal, does not lie close to the vein, until towards the lower third of the leg. Similar to the internal, it is situated sometimes before, sometimes behind, the vessel, following its distribution. In operations, we should endeavour to avoid puncturing, incompletely dividing, or dragging upon these nerves.

The posterior tibial alone forms the second class. Placed between the two principal arteries, it more particularly follows the tibial, lying almost completely behind it, at the lower part of the leg. It is extremely large, and the continuation of the internal popliteal, and, being placed between the two layers of muscles, it is almost completely sheltered from external violence; but it lies so close to the artery, that it may be injured, included in the same ligature, or even tied for that vessel.

The internal region of the leg, formed by the parts reposing on the internal surface of the tibia, is very distinct superiorly, and convex, like that bone. Inferiorly, it is lost, as it were, in the anterior and posterior regions.

The *skin*, covered with hair, is thicker and more dense than in the anterior region. Thus, in wounds with loss of substance, it is, most frequently, extremely difficult to obtain union by first intention. In the circular amputation, according to the method of J. L. Petit, we are obliged to dissect it to a great extent, to allow of its being raised to the same level as that of the posterior region. Sustained merely by the bone, it may remain pendent, and mortify after the operation.

The *subcutaneous layer* is formed of lamellæ and interlaced filaments, uniting the integuments very firmly to the periosteum; fluids, therefore, rarely collect, and abscesses habitually remain circumscribed, as do tumours of all kinds; especially sanguineous,

which, in consequence of the thickening of the surrounding periosteum, offer the same characters as in the cranium. It, moreover, encloses all the vessels and nerves of this region.

The *aponeurosis* of the leg, attached to the anterior and internal border of the tibia, does not exist here.

The *arteries* are merely the capillary ramifications of those branches, which have already been described. The internal malleolar, furnished by the anterior tibial, when very largely developed, is the only one meriting attention. Hence we may practise all kinds of incisions and operations on the front of the tibia. The internal saphena *vein* at no part offers more interest. Enveloped in the deep layers of the subcutaneous tissue, it is only separated from the bone by periosteum. As this disposition does not vary, the saphena appears very deeply seated in fat individuals, and much more superficial in thin; hence bleeding from the foot is more difficult in women than men. We may cut down upon it in all directions, and as far as the bone, without danger. The only organ to be avoided is the internal saphena nerve; but as its situation is irregular,—as it is sometimes in front, sometimes behind, we cannot lay down any rule for its avoidance, unless it be to open the vein parallel to its length. With regard to the accidents attributed to puncture of the periosteum, it appears more natural to refer them to lesion of the nerve; consequently, in penetrating to the bone, we, in point of fact, run no other risks than of breaking the point of our lancet, and occasionally producing a small abscess, with more or less severe pain. Varices most commonly commence above the internal malleolus; the trunk of the saphena, already of large size, being there unsustained by any muscular portion capable of favouring circulation. This situation is also very frequently the seat of *callous*, *sordid*, *varicose*, &c. ulcers, the cicatrization of which is generally very difficult, and sometimes attended with danger. The saphena vein, when varicose, being retained, to a certain degree, by the density of the integument, sometimes re-acts backwards with such violence, as to groove the tibia, and may thus lead to the belief of disease of the bone. This is a disposition which I have frequently observed, and which varices rarely fail to produce in old age.

The *lymphatics* are arranged in only one layer, and ramify in the subcutaneous cellular tissue, in extending to the anterior and posterior regions.

The *internal saphena* nerve has already been sufficiently described in speaking of the vein.

The *skeleton.*—The two bones of the leg, united by the interosseous ligament, circumscribe an elongated fossa in front, converted by the aponeurosis into a canal, larger and deeper at the union of its two superior thirds than at its extremities. The muscles, being imbedded here, are difficult to cut in cir-

cular amputations, at the same time that its depth prevents the formation of a good flap. Posteriorly they form a gutter or fossa, larger than the preceding, but also much more shallow, excepting below, where the surfaces of the fibula and tibia approximate closely. Hence, the deep muscles are easily comprehended in the flap in amputation, whilst if they were as large as those of the anterior region they would project much more posteriorly. The fibula lying on a plane posterior to that of the tibia, the external border, and about the posterior half of the corresponding surface of that bone, are situated behind the interosseous ligament. In the fœtus, the tibia presents merely a slight curve, which appears to be augmented in the adult, by the weight of the body on the one hand, and the resistance of the ground on the other. The posterior muscles, stronger and more numerous, acting on the flexible bones, concur to the same end.

Thus, in fractures, particularly from indirect causes, the angle formed by the fragments of the tibia is almost always in front, and the limb bends in the situation of the fracture. When the leg is placed horizontally, by its posterior surface, on a solid plane, the tibia, merely resting on its two extremities, breaks in some point of its body, before the weight pressing it anteriorly can remove the curve. Its periosteum, very thick and vascular, is not, however, sufficient to explain the frequency of its diseases. As this bone is merely covered by the skin and subcutaneous tissue, we may almost always feel it externally, distinguishing its deformities and fractures.

The two bones of the legs may be broken together or separately. The tibia, notwithstanding its size, breaks very frequently; more so, even, than the fibula, because it alone sustains the whole weight of the body, whilst the other has nothing to support. Instead of drawing the tibia outwards, the muscles rather push it inwards. Fracture may occur on any point of the bone, but it is evident that it must be more frequent towards the point of union of its inferior with its middle third, than anywhere else. It is there that its two curvatures join, that it is weakest, and that concussions are most intensely felt. The support it derives from the condyles of the femur, and the solidity of the ligamentum patellæ, show how it may also break between the articulation and its tuberosity, as in the example presented in 1825, related by Beclard; which, he said, was produced by muscular action. In consequence of its thickness at this point, fractures are ordinarily transverse, whilst the abundance of spongy tissue causes them to unite quickly and easily. Its anterior surface being subcutaneous, and not covered by any artery of importance, indicates the region which should be chosen for exposing it, when we would remove a portion, trephine, extract sequestra, balls, &c. Superiorly, as its external region is merely covered by the

origin of the tibialis anticus muscle, it is favourable to the same operation; I penetrated to at least within an inch of the articular cartilage, in extracting a sequestrum from a patient, in 1832. As the loss of this bone does not render walking absolutely impossible,—since, in the example cited by Cruveilhier, the limb had preserved all its functions,—it is much better to extirpate it, as we do the fibula, than to amputate above. The fibula, not lying upon the foot, but thrown, as it were, outwards, and a little backwards, appears there merely for the purpose of multiplying the inserting surfaces for the muscles. In some cases, notwithstanding its fracture, the patients are able to stand, and even walk; Desault considered that we might extirpate the middle portion, without destroying progression, and the patient, from whom M. Sentin removed nearly the whole, is completely cured. In its superior half, its fracture is rarely accompanied by displacement, because the portions of the bone are then supported by the muscles. The reason of the fibula breaking more frequently some inches above the malleolus than at any other spot is, that, being already curved inwards, this, the weakest point, receives nearly the whole effort of the foot. The anterior surface of this bone, becoming external, is subcutaneous to about three inches above the external malleolus; that is to say, as far as the point where the lateral peronei muscles separate from the anterior.

The *skin* being more adherent here than posteriorly, in front, or above, we sometimes observe a depression in swelling of the bottom of the leg, in consequence of accidents capable of producing fractures of the fibula, whether the bone be or be not broken. The inter-osseous space having disappeared, there is scarcely any sensible displacement, and the patient retains his power of walking. Lower down, fractures do not absolutely require any apparatus. Instead of moving the foot with one hand, to feel the crepitation or the mobility of the fragments, whilst the other embraces the fixed point of the limb, it is better to press with the thumb upon the summit of the malleolus, so as to make the inferior fragment project. In the ordinary situation the action of the lateral peronei muscles, on the one hand, and, on the other, the attempt made by the foot to turn outwards, approximate the two fragments of the tibia; hence, to obtain perfect apposition and consolidation, we should at first oppose transverse displacement, which we accomplish best by means of ordinary apparatus, taking care to give most length to the external splint, in order to place a sufficient quantity of padding between it and the heel.

There is rarely much displacement, as regards the length of the bones, at whatever point their fractures may have occurred, unless the cause has continued to act after the solution of continuity. This appears to result from the muscles being inserted over the whole of the bony surfaces. The superior portion of

the tibia then, projecting externally and posteriorly, more or less elevates the integuments in this situation. May not this peculiarity, which appears inexplicable to Boyer, depend upon the bone being slightly convex in front and internally, whilst it is thicker externally? In short, does it not appear, that, in falling upon the feet, the movement would tend to augment this curvature, and that its internal lamellæ, being the weakest, would be the first to break?

The *skeleton* of the leg also merits much attention in amputations. The section of the flesh, which can only be effected in the circular operation, by passing the point of the knife transversely over the bottoms of the inter-osseous fossæ, is equally difficult in the flap method, especially for the anterior flap, in consequence of the depth of the spaces in which the muscles are lodged. The inter-osseous space being largest towards the middle of the limb, need not be traversed with the instrument above and below, before we saw the bones; whilst, unless we turn the foot inwards, the backward inclination of the fibula obliges us to elevate the wrist considerably, in sawing it at the same time as the tibia. Thicker and more solid, the latter should receive the first action of the instrument; but should not be the first divided, as the other is too thin and mobile to support the movements of the saw, without breaking at the termination.

The precaution of always standing internal to the leg when we amputate, is far from being indispensable. It would not be much more difficult to divide the fibula before the tibia, by depressing the handle of the saw, if we stood externally. After the division of the small bone of the leg, its two ends should be pressed against the other, to avoid jarring the two peroneo-tibial articulations. After the removal of a limb, the tibia presents a triangular section, with its apex looking forwards. As the skin covering it is merely invested by the subcutaneous layer, it may become thin, ulcerate or slough, and if immediate union has not taken place, end by exposing the bone. In which case, M. Beclard and Mr. Guthrie, and other military surgeons, have recommended the point to be sawed off; but this advice is of little importance. Since the bones make the wound about two inches and a half or three inches across, and their thickness from before backwards is not more than an inch and a half, one of the angles of the union would look inwards and forwards, whilst the other would be turned outwards and backwards.

If, like MM. Larrey and Jarrique, we amputated above the tuberosity of the tibia, we should run the risk of opening into the knee-joint, as the synovial membrane is sometimes prolonged thus far. Since I mentioned this anatomical fact, M. Lenoir has proved, that the synovial cavity of the knee is continuous with that of the superior tibio-fibular articulation

once in four times, and once in two it descends as far as or behind the head of the fibula; in which case there is a communication between the knee and the bursa mucosa beneath the patella. There are always three principal vessels to be tied in this operation; first, the anterior tibial, placed immediately on the inter-osseous ligament, must be isolated from its collateral nerve, which lies immediately upon the inter-osseous ligament; secondly, the posterior tibial, applied on the anterior surface of the deep layer of the aponeurosis, opposite the point of contact of the common flexor and tibialis posticus muscles; thirdly, the peroneal, enveloped in the fleshy fibres of the flexor proprius pollicis, and which requires no precaution in the application of the thread. These three arteries sometimes retract so far into the flesh, after amputation of the leg, that, to secure the first, we are obliged to cut through the inter-osseous ligament, to the extent of some lines on each side. I have already observed, that M. Ribes accounted for this, by the angle which it forms in passing from the posterior region to the front of the leg. Without completely rejecting this explanation, which appears to me merely applicable to the anterior tibial, I consider, with M. Gensoul, that this fact is better explained, by the attachment of the muscles over the whole extent of the inter-osseous fossæ which prevents their yielding, whilst the vessels enveloped in supple lamellous cellular tissue, retract considerably.

A little higher, we must add, the two gastrocnemii branches, and the nutritious artery of the tibia, before it enters its bony canal. In some cases, this latter branch bleeds so freely, that we are obliged to have recourse to art in arresting it. I have seen, like M. Lenoir, that it enters its canal at two or three inches beneath the tuberosity of the tibia, being previously contained in a gutter, from two to nine lines in length, transformed into a canal by a fibrous lamella; arrived in the medullary canal, it furnishes an ascending branch for the condyles, and a descending branch for the body of the bone; in amputation at the usual spot, it must be so torn by the saw, that any ordinary measures would be unavailing; and rather higher, being cut in its canal, it can only be easily tied, by entirely dividing the fibrous fold which covers it; opposite the tuberosity we completely avoid it.

The bones of the leg being nearly as numerous below as superiorly, and the muscles reduced to their tendons inferiorly, we generally, in spite of the rule, to remove the smallest possible portion of the limb, prefer amputating three or four inches below the tibial tuberosity, unless the disease obliges us to proceed yet higher.

Cicatrization, and the anatomical disposition of the parts, prevent much facility of walking with the assistance of any of the known machines, after amputation of the inferior third of the leg. This is not, however, sufficient reason to proscribe it;

on the contrary, we have every reason to believe, that fresh improvements in *prothesis* will enable us to have frequent recourse to it. The operations of MM. Riberi, Goyrond, Roux, Blandin, and myself, and the machines invented by MM. Salemi, Mille, and Martin, justify this opinion, which I first published in 1826.

Without being as complete as in the fore-arm, the fibrous sheaths of the leg are sufficiently distinct to be traced externally from so many corresponding fissures. Conducting to the arteries, as do the intermediate eminences to the bodies of the muscles, these fissures require much attention in operations. Anteriorly, one falls between the tibialis anticus and common extensor, and is a certain guide to the tibial artery; another, separating the extensors from the peroneus longus, corresponds to the most superficial point of the fibula. More externally, that presented by the calf conducts to the peroneal artery, as the first does to the tibial. The sheath of the two peronei muscles is so strong, that pus may traverse it from one end to the other, as I once saw in a patient affected with caries of the superior tibio-fibular articulation.

SECTION FIFTH.

TIBIO-TARSAL REGION.

This portion of the limb, comprehending the malleoli, instep, and inferior portion of the tendo Achillis, offers, internally and externally, the malleolar eminences, behind which we see the termination of the tibio-peroneo-calcaneal gutters. Transversely, on the instep, the finger discovers, from within outwards, first, a depression separating the internal malleolus from the tendon of the brachialis anticus; secondly, a projection depending on this tendon; thirdly, a second depression, separating it from the corresponding tendon, and the flexor proprius pollicis; fourthly, another eminence, corresponding to the common extensor.

Internally we see, first, the malleolar eminence; secondly, a small excavation, beneath and in front of its apex, separating the tendon of the tibialis posticus from that of the anticus; thirdly, at six or eight lines behind, a small eminence, presenting no other interest than that it corresponds to the posterior insertion of the fibrous sheath, separating the common flexor tendon from the other soft parts.

The *skin*, thin, slightly elastic, should be as much as possible preserved in operations.

Over the malleolus, the subcutaneous tissue being very dense,

abscesses or effusions rarely occur. Surrounding this eminence, it assumes the characters distinguishing it in the neighbouring regions. In front it is at the same time lamellous and filamentous; posteriorly, it is only filamentous, and forms a very dense and granular cellulo-adipose layer, explaining the violence of the pains attending acute inflammation.

The *periosteum*, very dense, adheres strongly to the bone. The malleolus receives in front the extremity of the anterior tarsal ligament.

The internal tarsal ligament arises from its posterior border, to pass over the internal eminence of the heel, whilst from its summit arises the internal lateral ligament of the joint. These three fibrous bands, sometimes united by their margins, are in reality merely dependencies of the aponeurosis, with which the two first are evidently continuous. But the internal annular ligament is the only one necessary to be examined here. Derived from the tibial aponeurosis, the fibres of which are there stronger and more approximated, it converts the tibio-calcaneal fossa into a complete arch, and thus binds down the tendons, vessels, and nerves which pass from the posterior region of the leg to the sole of the foot.

This arch is at first divided by a septum, a mere continuation of the deep fibrous membrane of the leg, and which transforms the posterior inter-osseous fossa into a canal. Its anterior portion is in its turn divided into two, by a second very short and thick septum. The one, posterior, larger, and much less solid, encloses the flexor proprius pollicis, the posterior tibial vessels and nerves; the other, anterior, forming a very solid osteo-fibrous canal, is likewise divided into two narrow sheaths, one over the other, for the common flexor tendon behind, and for that of the posterior tibial in front. We should recollect this anatomical arrangement when we would tie the posterior tibial artery behind the malleolus.

The *tendon of the tibialis posticus*, the thickest and shortest of all, might be easily exposed in its sheath, if we cut too much in front. It is as well to remark that, terminating at the scaphoid bone, this sheath, when inflamed, does not necessarily produce suppuration of the deep-seated parts of the plantar region.

The *tendon of the common flexor* does not lie simply on the posterior portion of the malleolus, but also on the tibio-astragalar articulation, and on that of the astragalus with the heel; phlegmonous inflammation of its sheath, therefore, is much more dangerous than of the preceding.

The *flexor proprius pollicis*, preserving some fleshy fibres, is in the same sheath as the vessels and nerve. At first, enveloped by loose cellular tissue, it soon enters a peculiar sheath, crossing, from without inwards, the posterior surface of the astragalus, and the above-named tendons, to reach the inferior surface of

the lesser head of the os calcis. Without having any peculiar synovial membrane, it meets with one at the expense of that of the common flexor.

Sometimes flexion of the toes causes a certain noise in this region, accompanied by pain and swelling. This is a condition, similar to that which I have indicated in speaking of the long adductor and short extensor of the thumb. A patient treated at the Hôpital de la Faculté, in 1825, presented it in a very marked manner. In another I saw the sheath of the tibialis posticus distended by a large quantity of synovia.

Arteries.—Several branches of the internal malleolar are found in front; the posterior tibial is the only one meriting any attention. The tendon of the flexor proprius pollicis is external, and the nerve posterior; the sheath of the common flexor is in front, and a little internal. On the inner side, and a little posteriorly, the artery is only covered by that portion of the internal annular ligament continuous with the aponeurosis of the leg. We are, consequently, sure to find it by making a semilunar incision two or three lines behind the internal malleolus. If the nerve is exposed, we may easily secure the artery, which is always in front.

Veins.—The *internal saphena*, passing from the back of the foot to the internal tibial region, ordinarily ramifies in front of the malleolar prominence; we sometimes puncture it in this situation; but it is better to bleed higher up.

The *lymphatics* present nothing here, with regard to surgery, that has not already been mentioned in the preceding region. The *internal saphena nerve* is disposed, relative to the vein of the same name, as in the tibial region. The *posterior tibial*, which more superiorly was external to the artery, terminates internal to it, even before it abandons the tibio-calcaneal arch. A tumour as large as a hen's egg, which had transformed it into a membrane, in a female upon whom I operated with Dr. Branzeau, of Sévres, had caused no derangement either in the sensibility or mobility of the sole of the foot.

The *external malleolus*, separated from the dorsum of the foot, by a cavity corresponding to the astragalo-calcaneal excavation, is separated from the heel by the termination of the peroneo-calcaneal gutter. Between and beneath these two depressions, we feel a relief formed, at first, by the lateral peroneal tendons, next by the tuberosity of the external surface of the calcis.

The *skin* is here more supple, and much more extensible than over the internal malleolus; hence, it does not tear with the same facility, when the foot is turned inwards.

The subcutaneous tissue, supple and lamellous over the malleolus, is filamentous only behind; this disposition is, also, much less marked than in the neighbourhood of the internal malleolus. It here forms a bursa mucosa, as at the knee,

especially in tailors. Sanguineous tumours and abscesses may then be developed; I have met with two examples, in April and May 1833.

From the edges, as well as from the apex, of the malleolus, the aponeurosis diverges, under the form of more or less distinct bands, and passes over the front and external surface of the calcis; so as not, evidently, to make a portion of the fascia of the leg, excepting quite posteriorly and superiorly. It is, also, in this direction that it forms a sheath for the lateral peroneal tendon, single as far as the base of the malleolus, but speedily divided into two, by a septum attached over the external crest of the calcis. Before its bifurcation, this osteo-fibrous canal is extremely strong and solid; it soon becomes weak, and terminates by being converted into cellular tissue, at least in that portion belonging to the peroneus brevis.

The *lateral peronei tendons*, placed at first on the external surface of the fibula, wind gradually backwards. The sheath enclosing them appears merely to be the continuation of the aponeurotic canal, which preserves them isolated in the leg. I have observed some facts, which might lead us to admit, that it may tear, permitting the two tendons to ascend over the external surface of the malleolus; this would be a very serious accident. Besides the pain and inflammation which might result, the action of the muscles would be reversed. Instead of remaining an extensor, like the tibialis posticus, the peroneus brevis would become a flexor, and the action of the other almost reduced to abduction. As it is at first common to them, although that of the one is soon lost on the back of the foot, its injury is not the less dangerous, as that of the other quickly transports the inflammation into the plantar region. Their friction behind the malleolus causes these tendons to produce swelling and painful crepitation, already noticed in speaking of the internal sub-malleolar sheath.

The external malleolar artery, the posterior branch of the peroneal behind, when it exists, the anterior branch of the same trunk in front, and some other ramifications of the anterior tibial, are met with in this region, but do not merit any attention in the performance of operations.

The *veins* accompanying the arteries are not more important. One only is worthy of remark; that is, the external saphena. Coming from the back of the foot, like the internal, it passes behind the malleolus, to arrive at the peroneo-calcaneal gutter. Although very large in some subjects, it is, nevertheless, rarely opened, because the operation is commonly more easy on the internal.

The *lymphatics* are nearly all superficial.

The *external saphena nerve* is alone met with in the neighbourhood of the external malleolus. Giving several branches to the

cellular tissue of the external surface of the heel, and accompanying vein, it must concur in rendering phlegmonous inflammation of this part exceedingly painful.

Comprised between the two malleoli, the head of the astragalus, and the anterior tibial region, the *instep* presents on its exterior, from within outwards, the eminences and depressions described in the commencement.

In peasants, particularly those who do not wear stockings, the skin is very thick and rough. Generally a little denser than in the surrounding regions, it often presents transverse wrinkles, evidently depending on the movements of the foot upon the leg. We here meet with numerous follicles, secreting abundantly, and explaining, in part, why this region of the foot soils sooner than the others, and is sometimes cracked.

The *subcutaneous tissue*, or continuation of that of the leg, encloses a great quantity of fat. Its laminæ condense and approximate as they descend, so that from one malleolus to the other, the integuments are very strongly united to the annular ligament, and subcutaneous infiltrations are generally arrested by this band. Superficial abscesses also spread with difficulty, from the bottom of the leg, over the dorsum of the foot, and infants, as well as fat individuals, have the instep, as it were, constricted.

The *aponeurosis*, continuing that of the anterior tibial region, is at first very thin, and almost simply cellular. Having formed the anterior annular ligament, it again becomes thin, to give origin to the dorsal aponeurosis of the foot. The transverse band uniting the two malleoli is remarkable for the sheaths with which it furnishes the tendons. Without it the flexor muscles of the foot would be considerably separated from the front of the articulation in contracting. The space dividing it from the articulation, the lamellous cellular tissue filling this space, and the membranes surrounding or uniting the tendons, show that abscesses are dangerous. Retained by the fibrous tissues above, below, and towards the skin, driven backwards they may spread towards the pulley of the astragalus, or the astragalo-scaphoidal articulation, and thus give rise to the most serious mischief. We must, consequently, open them *early;* but, on the one hand, their depth does not admit of their being recognized until very late, and, on the other, the tendons between which we must pass render incisions very difficult. Broad and strong internally, it appears at first formed of two bands, placed one above the other, splitting to form a sheath for the tibialis anticus. The posterior layer of its inferior portion is stronger than the anterior, and it is particularly the latter which constitutes the *anterior annular ligament of the tarsus.* After having sheathed the tendon of the tibialis anticus, it again splits to embrace that of the extensor proprius pollicis at first, and sub-

sequently those of the common extensor and the peroneus tertius. Thus, the former is separated from the latter by a thin but strong septum, resembling tendinous synovial membrane, rather than true fibrous lamellæ.

Seven tendons traverse this region. That of the tibialis anticus, enclosed in its double sheath, descends obliquely towards the internal cuneiform bone. That of the extensor proprius pollicis, sliding in a softer sheath, also, passes obliquely towards the dorsal surface of the first metatarsal bone. The four branches of the common extensor, assembled in a fasciculus as far as their exit from the annular ligament, immediately spread towards the roots of the four outer toes. Lastly, that of the peroneus should only be considered as a fifth branch of the common extensor, which passes in the same sheath. United by synovial membrane, which accompanies them as far as the dorsum of the foot, wounds penetrating these sheaths are extremely dangerous. That of the tibialis anticus is the only one which I have hitherto seen surrounded by collections of pus, blood, or serum, as in the bursa mucosa. In two patients the tumour extended for more than two inches above the malleolus.

Arteries.—The anterior tibial, which here takes the name of *dorsal artery of the foot*, is the only branch of any size met with. The malleolar commonly arises from it a little higher, and the dorsal branch of the tarsus more anteriorly. Thus, placed between the common extensor and the extensor proprius pollicis, it is always a little nearer the internal than the external malleolus. To expose it, we must cut in the median fossa of the tarsus, parallel to the external border of the extensor of the tendon of the first toe. But this ligature is rarely attempted; first, because the artery is too deeply seated; secondly, because it is not always possible to avoid the tendinous sheaths, and prevent inflammation; thirdly, because the operation, very easy above the malleoli, there presents the same advantages, without the same dangers; fourthly, because it is easily compressed.

The principal veins accompany and surround this artery; the subcutaneous tissue only enclosing some few small branches, which empty themselves into the saphenæ, and rarely become varicose.

The *superficial lymphatics*, irregularly disseminated, pass into the internal and anterior tibial region. Those accompanying the blood vessels are not of any importance.

The two *superficial nerves* of the dorsum of the foot, derived from the bifurcation of the musculo-cutaneous, lie in the deep layer of the subcutaneous tissue. The deep-seated continuations of the anterior tibial follow nearly the same direction.

Separated from the malleoli by the widest portion of the peroneo and tibio-calcaneal fossæ, the tendo Achillis forms a perfectly isolated cord at some distance from the articulation of

the leg. A sword, or any other similar instrument, might easily traverse the leg in front of it, without wounding or touching either vessels or tendons.

The *skin*, thick, wrinkled, cracking with facility, especially posteriorly, becomes gradually thinner over the sides, and soon assumes the characters of that covering the malleoli.

The *subcutaneous tissue*, filamentous, adheres very firmly to the aponeurotic and cutaneous layers. Approaching the heel, it becomes elastic, thick, and merges into the cushion, which we shall find in the sole of the foot. It is here that the three aponeurotic layers of the posterior tibial region terminate. Continuing, on the one hand, with the calcaneo-malleolar fibrous bands, or the sheaths of the tendons, and, on the other, burying themselves, quite posteriorly, in the elastic subcutaneous tissue.

The tendo Achillis, remarkable behind the malleoli, as in its whole extent, for strength and size, is so, likewise, from the manner in which it is inserted into the calcis. Attached only to the inferior half of the posterior surface of this bone, it is separated from the other by a very distinct synovial bursa, sometimes distended with fluid. Thus disposed, it may act with greater force upon the heel; but a transverse incision may almost completely separate it from the os calcis, at an inch above its termination. Its rupture presents the same peculiarities as at the bottom of the leg; only, if it occurs quite low down, the adherence of parts being much stronger, its retraction will be less.

The arteries, veins, lymphatics, and nerves are of no surgical interest here.

Skeleton.—Internally the skeleton of the tibio-tarsal region, naturally comprising the internal malleolus, would also comprehend the internal surface of the astragalus, and a portion of that of the calcis, if these parts did not enter more particularly into the composition of the foot. Prolonged to conceal the tibio-astragalean articulation, thus protected against external injury, oblique inwards, applied very firmly against the first bone of the tarsus, very thin in comparison to the size of the tibia, and very solidly fixed by its apex to the lesser tubercle of the os calcis, as well as to the rough portion of the tibial surface of the astragalus, the internal malleolus may break when the foot is turned on its inner border, rather than allow dislocation. The gutter grooved on its posterior border, and which is continuous, beneath its apex, with the internal lateral ligament, forms a complete pulley for the tendon of the tibialis posticus. The bottom of this gutter is invested by a very dense fibrous layer, the free surface of which is very frequently converted into cartilage, sheltering the synovial membrane of the joint during the action of the muscles.

The inferior fifth of the fibula especially constitutes the

skeleton of the tibio-tarsal region *externally*. We may, also, add a portion of the external surface of the astragalus and calcis. It consequently comprises the inferior peroneo-tibial articulation, the fibrous apparatus of which is composed of the anterior and posterior peroneo-tibial ligaments, and of yellow tissue, fixing the fibula in the sygmoid cavity of the tibia, and known as *the inter-articular ligament.*

Although immobile and very firm, this articulation is, nevertheless, susceptible of diastasis or separation, an accident which appears frequently to accompany severe sprains. Prolonged more downwards than inwards, the external malleolus is better disposed to support the foot, which, from its disposition, continually endeavours to turn outwards; on the other hand, like the internal, this malleolus conceals the joint, and presents a still deeper gutter on its posterior surface. The synovial membrane of the calcaneo-astragalean articulation is so loose, that it frequently escapes between the two lateral peronei muscles, in front or even behind their sheaths, forming true *nodes* or *ganglions*, which should not be opened.

The *skeleton of the instep* presents merely the horizontal articulating surface of the tibia, and a portion of the superior surface of the astragalus. The synovial membrane, being merely supported in this direction by a very thin fibrous membrane, easily projects beneath the annular ligament, and especially in the lateral or malleolar excavations. The articular surface of the astragalus, convex from before backwards, and forming a kind of pulley, allows very decided flexion of the foot on the leg, which is also favoured by the notch found in front, separating it from the head of the bone. However, abutting against the anterior surface of the tibia, this notch almost invincibly opposes luxations of the leg backwards, unless the foot trips, or the weight of the body is augmented by a fall or heavy burden. When this displacement occurs, the tibia, carried on the posterior notch of the os calcis, is only arrested by the tendo Achillis.

The dorsum of the foot is forcibly turned back on the front of the leg, and if there be no complication, reduction does not appear to be very difficult. It will be quite sufficient to observe carefully how the astragalus is imbedded in the tibio-fibular mortise, to convince ourselves that this cannot be the case in internal or external luxation.

The joint is so badly protected in the region we are studying that any pointed or cutting instrument may open it, by penetrating the different fossæ indicated in speaking of the exterior of the notch.

The os calcis, supporting the weight of the body, by the middle portion of its superior surface, projects sufficiently backwards beyond the leg for foreign bodies, and sometimes even the action of the muscles of the calf, to fracture it; on the other hand, the transverse, rounded fissure separating the articular

surface from the tendo Achillis concurs in forming the vault or deep groove which we remark on its inner surface.

The frequency of luxation, in the direction of the *internal malleolus*, is partly explained by its descending less than the *external*, and thus sustaining greater stress upon its ligaments. As to the posterior surface of the articulation, the ligaments slightly augment the depth of the peroneo-tibial cavity, whilst the astragalus, very strongly inclined backwards, but not projecting beyond them, is, also, more easily pushed forwards. However, we may imagine, from the weakness of the ligaments, and the disposition of the surfaces, that, in certain cases of forced extension, the leg may be thrown on the dorsum of the foot, and the astragalus turned on the posterior surface of the tibia.

The weight which the tibio-tarsal articulation supports, and the friction produced by the constant action of the parts, account for the frequency of its diseases. The loose synovial membrane investing its surfaces, sustained posteriorly by the tendo Achillis, never projects in that direction. The narrowness of the external lateral ligaments would allow it, on the contrary, to escape between them, if the malleolus did not present an obstacle. The internal fibrous band retains it too firmly within for it to present itself there. In front, the ligaments but feebly oppose it, but the annular ligament and the tendons soon press it towards the sides. Hence, it is in front of the malleoli, and behind the external, that it usually projects in hydarthrosis and white swelling. It is equally at these points that the integuments become disorganized, when it is torn or ulcerated, even if the opening of the articulation occurs in quite another region. No other region offers so many inequalities, and it is very difficult to apply exact compression. The length of the antero-posterior diameter, where it extends from the instep to the calcis, and the continual tension of the extensor tendons of the toes, account for the fatigue, and even pain, caused by the turns of the bandage in this situation.

The extremities of the bones of the leg are so superficial beneath the skin that, the operation for removing them separately, by exposing them one after the other, is, at once, less difficult and less dangerous than might at first be considered. The lateral tendons, pushed towards the median line, allow us to introduce a chain-saw between the tibia and fibula, which we immediately separate from above downwards. The numerous cases in which this operation has been performed for luxations, complicated with projection of the bones through the torn skin, prove that the functions of the foot are, in a great degree, reestablished, and that such an operation deserves to be retained in practice. If we treat caries or necrosis of the summit or external surface of the malleoli, we may, as I once did, content ourselves with simply removing the diseased parts, without opening the synovial or articular cavity.

SECTION SIXTH.

OF THE FOOT.

The foot, in many respects resembling the hand, is so disposed, that, in the upright position, its inferior surface rests horizontally upon the ground, whilst the superior receives the weight of the body towards the union of its three anterior with its posterior fourth. Its form is that of an irregular triangle, the base represented by the toes, and the apex by the heel.

Limited by the instep posteriorly, and by the union of the toes in front, the *dorsal region* of the foot, more or less convex internally, gradually flattens, appearing to spread out in front. Posteriorly, we distinguish an eminence, very marked in some individuals, corresponding to the fleshy portion of the extensor brevis digitorum. Towards the inner margin, we remark a continuation of the eminences and depressions described in the instep. Through the skin, in front, when the toes are extended, we may feel the tendons and gutters separating them, especially in thin persons. By an attentive examination, we also discover a great many other objects, more important even than the preceding; but as they relate particularly to the articulations and amputations, I shall return to them in speaking of the skeleton.

In early life, and in the female, the *skin* is extensible and very supple. In man, it habitually supports a small group of hairs, on the most convex portion of the region; and among peasants, we not unfrequently see it wrinkled, cracked, and covered with scales, as at the instep. It sometimes thickens, forming a tumour of greater or less size, and from the same cause ulceration and wounds, with loss of substance, cicatrise slowly and with difficulty.

The quantity of the *subcutaneous tissue* varies considerably. In women and children, it frequently obliterates all the inequalities of the region, whilst, in man, it rarely acquires such thickness; and, although thin, and like aponeurosis, in lean individuals, it swells considerably in inflammations. As it does not adhere very intimately to the skin and aponeurosis, suppuration ensues with great rapidity, and phlegmonous erysipelas is quickly succeeded by very considerable exfoliation. In amputations, it allows the integuments to be drawn sufficiently backwards to render dissection useless.

The *aponeurosis* of the dorsum of the foot has generally been very inaccurately described. We may trace it from the tibial border of the region. Its lamellæ separate to embrace the extensor proprius pollicis, of which they thus continue the sheath. Re-approximating external to this tendon, they again separate,

to pass, the one on the superficial, the other on the deep surface of the extensor brevis digitorum, and tendons of the common extensor, and re-unite, externally, by blending with the periosteum, and becoming continuous with the plantar aponeurosis. Posteriorly, it evidently prolongs the aponeurosis of the instep; anteriorly, being merely separated by the tendons, it unites with the synovial membrane; finally losing itself in the cellular tissue of the toes. Hence, we may have two kinds of abscesses in the foot; one, which, occurring in the subcutaneous tissue, may exist for some time without affecting the other elements; the other, developed between the layers of the fascia, remaining unrecognized longer than the preceding. Inflammation, also, frequently extends immediately from one to the other, and pus first accumulated beneath the aponeurosis soon ruptures it, to reach the subcutaneous tissue and raise the skin. Fluctuation is, therefore, easily distinguished in both these cases, in consequence of the thinness of the soft parts.

Muscles and *tendons.*—The continuation of the tibialis anticus, passing in front of the internal surface of the scaphoid bone, to attach itself to the inferior border of the cuneiform, makes so distinct a projection, when stretched, that it may be completely divided, transversely, without injury to the tibio-tarsal articulation.

The *extensor proprius pollicis*, rather obliquely crossing the articulations of the astragalus and scaphoid, the scaphoid and the internal cuneiform, and of the latter with the metatarsal bone, before reaching its insertion, may act freely and independently of those surrounding it; in the same manner that its synovial investment may be affected singly, and that without implicating the others, it may be divided, by cutting on the superior surface of the internal border of the foot. The four tendons of the common extensor separate, and spread the synovial tunic, which invested them at the instep, into a membrane; and, as they pass towards the back of the toes, cross the external surface of the short extensor very obliquely.

The *peroneus tertius* spreads over the superior surface of the fifth metatarsal bone. As all these tendons ramify between the layers of the aponeurosis, we know to what depth we may penetrate without reaching them; and, also, from their situation, and the space separating each, in what direction we should incise to avoid them, and what injuries are most likely to divide them.

The *extensor brevis digitorum*, arising by a point from the astragalo-calcaneal excavation, soon divides into four, sometimes five, portions, to pass to the four first toes in one case, and to the whole five in the other. Of these the internal, or first, is the most important in surgery, and nearly always the largest. It is so disposed that, in deep incisions, where we would preserve the tendons of the long common extensor, we rarely fail to cut it across.

Arteries.—There is only one deserving any attention, the continuation of the tibial; it bears the name of the *dorsal artery of the foot*, and is separated from the bones merely by a fibrous layer, confounded with the ligament. Following the direction of a line drawn from the middle of the instep to the posterior extremity of the first inter-osseous space, it lies on the head of the astragalus, and its articulation with the scaphoid, on the dorsal surface of the latter; and, lastly, on the interstice between the two first cuneiform bones. Opposide the head of the astragalus, or some lines more anteriorly, it lies on the external side of the extensor proprius pollicis. The internal branch of the deep nerve follows its inner side. Externally, it is at first accompanied by the first tendon of the common extensor, and is two or three lines from it, when it arrives on the dorsum of the second metatarsal bone. In this situation, the first fasciculus of the short extensor muscle contracts the most important relations with it; posteriorly, it is at first several lines from it, but it gradually approaches, until its internal border covers it; hence it must be turned outwards to allow of the vessel being secured. To find it with certainty, we must cut in the direction of the line already indicated, and fall on the interval, separating the extensor proprius pollicis from the common extensor; as it is covered by the two layers of aponeurosis, the subcutaneous tissue, and integuments. Its anomalies are numerous; frequently given off from the anterior peroneal, it sometimes arises from the external or internal malleolar. I have seen it arrive by the external as well as by the internal calcaneal gutter, and run along the corresponding border of the foot. The dorsal arteries of the tarsus and metatarsus furnished by it are too small to require any attention in operations. We should, however, note the two branches which run from the internal portion of the same trunk, over the tibial border of the foot, passing between the tendons of the tibialis anticus and extensor proprius pollicis muscles. In fact, in some individuals, abundant hemorrhage may arise from dividing the tissues in front of the first of these tendons, although the trunk itself has not been wounded.

Veins.—The two saphenæ arise from a large arch, the convexity of which, turned forwards, receives all the superficial branches of the dorsal surface of the toes. Enclosed in the subcutaneous tissue, and covered merely by the skin,—raised, moreover, by the extensor tendon, this arch appears larger than the two veins to which it gives origin; hence, in some individuals, we are obliged to select it for phlebotomy, notwithstanding the proximity of the tendons and the mobility of the tissues may render it difficult and dangerous. We can rarely obtain a large quantity of blood, as it merely receives the veins of the toes. The softness of the tissues enclosing it allows the branches opening into its concavity, as well as all the venous branches of the dorsum of the foot, to dilate quickly. Thus favoured by the

thinness of the vascular walls, by the height of the column of blood, and occupying the most dependent portion of the body, varicose patches, or a more or less complicated plexus, are frequently remarked on the dorsal region of the foot. In consequence of the relations of these varices with the tendons, it would not be prudent to treat them by incision or excision, either with or without ligature.

Lymphatics.—The superficial plane is the most important; enclosing the roots of a certain number of vessels, which pass into the groin, it is not surprising that, in some individuals, inflammations and other affections of the dorsal surface of the foot produce swelling of the inguinal glands, or are referred to some point in the inferior extremity. They appear to perform an important part, especially in phlegmonous erysipelas, produced by a puncture, or any suppurating wound. In fact, in these cases, we frequently see the redness disseminated in patches, or under the form of more or less distinct striæ, and thus spread from below upwards, &c.

The *nerves* belong here to four principal branches: the two saphena, the musculo-cutaneous, and the anterior tibial. The internal saphena, almost entirely lost before arriving at the base of the first metatarsal bone, always follows the vein of the same name, and appears to terminate in the skin. The external, extending as far as the toes, to which it gives very distinct branches, also accompanies the vein whence it derives its name. Deeper than the preceding, we may say that it is enclosed in a kind of sheath, appertaining at the same time to the aponeurosis and the subcutaneous tissue, being ultimately lost in the skin and cellular tissue.

The two superficial dorsal, occupying the deep layers of the subcutaneous tissue, are further from the skin than the veins, and are separated from the tendons by the aponeurosis. Like the two saphena, they are lost in the cellular tissue and skin.

The two deep branches, terminating the anterior tibial, and lying almost immediately on the bones, are so arranged, that if the preceding supply sensation, these must preside over motion.

Being uninterrupted by the leg, the plantar region of the foot is much longer than the dorsal. Prolonged backwards, as far as the posterior extremity of the heel, on the one hand, it advances, on the other, nearly an inch beneath the toes. Projecting in front, posteriorly and on its external half it presents a more or less deep cavity, in the centre and internally, which receives the tibio-calcaneal gutter, and in some degree resembles the palm of the hand.

The *skin* presents greater thickness here than in any other part. Beneath the heel, it sometimes extends to two lines. A little less beneath the head of the metatarsal bones, it is still

thinner in the external half of the region, and we see it in the plantar excavation gradually assuming the characters distinguishing it in the palm of the hand. It almost presents the appearance of horny tissue. Forming a dense inelastic sole, it is thus favourably disposed to sustain the weight of the body, resist the inequalities of the earth, the action of foreign bodies, and allow man to walk bare-footed. Tumours and abscesses forming beneath it, meeting with considerable resistance, are developed but slowly, and produce excruciating pain, whilst fluctuations are, for a long period, undistinguishable externally. It is principally around the heel that cracks and chilblains occur during winter; we might find the cause of this disease in the organization of the integuments, did it not equally occur in the hands and the dorsal surface of the foot.

The *subcutaneous tissue*, a complete, elastic, fibro-adipose cushion, of great thickness, merely differs from the analogous layer of the hand, by its greater degree of elasticity, and by its denser structure. Formed of strong and resistant filaments, extending from the aponeurosis to the skin, interlacing and blending in a thousand different ways, it represents a net work, enveloping adipose vesicles. Its thickness, varying but little, is about three lines posteriorly, and diminishes in about the same proportion as that of the skin at other points. Its great elasticity performs an important part in station and progression, by deadening the pressure of the body on the integuments, and other soft parts of the sole of the foot. In consequence of its dense fibrous texture, severe accidents are commonly followed by general reaction; among the people of Africa and America, who still preserve the habit of walking bare-footed, tetanus, it is said, has frequently followed similar injuries. Abscesses, terminating these inflammations, may appear in a milder form, and not cause so much suffering. These collections are sometimes distinguished with difficulty, but it is necessary to make *deep* and *long* incisions at their commencement, as they quickly produce destruction and exfoliation of the skin to a great extent.

Aponeurosis.—When the preceding adipose cushion is raised, the sole of the foot appears divided into three portions, extending from the heel, to unite in spreading near the toes, representing the internal and external eminences and cavity of the hand.

One, continuous with the inner border of the foot, encloses a great portion of the muscles, passing to the first metatarsal bone and great toe; another, placed externally, is formed of the muscular fasciculi attached to the fifth metatarsal bone and little toe; a third, larger in front, but narrower behind, than the two former, extends from the middle of the heel to the base of the toes, enclosing principally the flexor muscles and tendons. The plantar aponeurosis covers these three eminences. Although isolated in appearance, we may, nevertheless, say, that it mingles, on the

sides, with the dorsal aponeurosis; posteriorly and internally, with the internal annular ligament of the tarsus; and that it arises from the posterior tuberosity of the calcis. It is thin, and almost cellular, on the internal muscular eminence. As it corresponds to the great plantar notch, inflammations and deep-seated abscesses proceed almost as in the external eminence of the palm of the hand, and wounds are generally less dangerous than in the rest of the region. Over the external eminence, it represents an extremely strong band, which comes specially from the external tuberosity of the calcis, and subsequently contracts gradually. Apart from the posterior eminence of the fifth metatarsal, where it fixes, completing the arch of the peroneus longus, it only forms a cellular or fibro-cellular layer, as on the internal eminence. Internally, however, a distinct fibrous band proceeds forwards, and is confounded with the aponeurosis of the median eminence. This, which constitutes the true plantar aponeurosis, is triangular, like the projection it invests. Very thick, posteriorly, at its point, (which more resembles a tendon than a *fascia*,) it thins in spreading, so that, towards the centre, its fibres separate to form five distinct bands, which bifurcate under the heads of the metatarsal bones for the flexor tendons of the toes, as we have seen with respect to the palmar aponeurosis. The band of the little toe is often wanting, as well as that of the first; occurring from the external and internal folds of the fascia being transformed into cellular tissue before reaching the phalanges. On each side, and in its posterior half, it mingles with the lateral portions, forming two septa; of which the internal is attached to the inferior surface of the internal cuneiform, scaphoid, and astragalus; whilst the external reaches the crest of the cuboid, and inferior surface of the calcis.

Muscles.—Each fleshy eminence of the sole of the foot is thus contained, as far as its centre, in a canal, half fibrous, half osseous. The most solid canal is that of the median eminence. The muscles, thus bound down, act with much more strength and facility. It is so disposed as to form at intervals small openings, by which the subcutaneous cellulo-adipose tissue is continuous with the deep cellular tissue, forming a means of communication for inflammation, and becoming, on the other hand, a cause of intense pain, by the constriction of the small inflamed portions which traverse them.

Those of the tibial eminence, in part, represent the muscles of the eminence of the thumb. The *adductor pollicis* is the most remarkable. Its fleshy mass, arising from the internal tuberosity of the calcis, on the one hand, and from the anterior border of the internal annular ligament of the tarsus, on the other, converts the vault of the calcis into a canal, and thus protects the tendons, vessels, and nerves coming from the leg to the foot. Filling the bony notch separating the posterior eminence of the tarsus from

that formed by the internal cuneiform bone, it is away from this latter point only that its tendon is isolated, and that it receives, by its external side, the fibres of the short flexor of the great toe, with which it becomes confounded. This latter then appears to replace, anteriorly, the fleshy portion of the preceding, which only exists behind. Inserted by a more or less elongated point, under the scaphoid and internal cuneiform, the short flexor is much larger and thicker under the first metatarsal bone; the internal surface of which it completely covers, by filling its concavity. As it appears to bifurcate anteriorly, to fix with the tendon of the preceding on the internal and with the oblique abductor on the external tubercle of the first phalanges, it forms a gutter, receiving the tendon of the long flexor of the great toe. As for the oblique and transverse flexors, they are entirely enclosed in the median tuberosity, excepting at their common attachment to the short flexor.

The muscles of the external eminence are the *abductor* and *short flexor* of the little toe. The fleshy portion of the first fills the bony notch, extending from the external and posterior tuberosity of the calcis to the crest of the cuboid. Its tendon follows the external border of the foot, unites to the posterior portion of the fifth metatarsal, and proceeds, enveloped by the fibres of the short flexor, to the posterior and external extremity of the little toe. It is ordinarily divided at the commencement of metatarsal amputation. The second, which arises by a point from the inferior surface of the cuboid and last metatarsal bone, re-unites to the preceding tendon, and continues with it to the posterior extremity of the same joint; these two muscles thus resemble the two principal fasciculi of the internal eminence.

The median eminence also encloses several. The short flexor, analogous to the flexor sublimis of the fore-arm, forming a single fasciculus in its posterior fourth, divides into four branches anteriorly. After bifurcating under the metatarso-phalangeal articulation, to give passage to those of the common flexor, its four tendons fix on the plantar surfaces of the first phalanges. The *common flexor* and *flexor proprius* of the *great toe*, which, in the calcaneal gutter, are at first placed, the former externally, the latter internally, then cross, and glide one beneath the other, to reach the inferior surface of the short flexor of the same appendix. That of the common flexor, continuing obliquely outwards to above the superior surface of the short flexor, there receives, by its border, the accessory muscle, which, rising from the external portion of the calcis, represents a sort of lozenge-shaped or square layer, its direction destroying the obliquity of action in the former. The four branches of the latter then, separating, give origin to the lumbricales, and proceed to their fibrous sheaths. Posteriorly it is divided from

the skin by the whole thickness of the adductor muscles of the great toe and short flexor; anteriorly it approaches them, so that the subcutaneous layer alone remains between them. Applied immediately on the bones, in the former situation, it is next separated from them by the inter-osseous and two adductor muscles of the first toe. Of the latter, the *oblique abductor*, occasionally inserted on the inferior surface of the second or third cuneiform bone, is almost confounded with the short flexor.

The *transversus pedis* is placed horizontally beneath the head of the metatarsal bones. Attached to the external side of the first articulation of the great toe, they may approximate the metatarsal bones to each other, and thus increase their concavity. The transversalis, also, separates the lumbricales tendons from the inter-ossei.

These latter, placed between the metatarsal bones, are seven in number; four for the dorsal region, of which two are for the second toe, and the other two abductors for the third and fourth; three in the plantar region for the three last toes, and all adductors. Not extending beyond the bones on the back of the foot, they, on the contrary, project more or less on its plantar surface, so that, in partial amputation, they enter into the composition of the flap.

The tendon of the peroneus longus, those of the tibialis anticus and posticus, must also be noticed; the first, extended from the posterior fissure of the cuboid bone to the prominence presented posteriorly, by the first metatarsal bone, enclosed in a sheath formed by the bones superiorly, and by ligaments or other fibrous layers inferiorly, may act independently of all the others, and without interruption, strongly raising the external border of the foot outwards, at the same time that it forcibly concurs in the extension of the limb. In fact, it winds over a double pulley in passing beneath the fibular malleolus, and over the external border of the cuboid bone. It is, therefore, of importance to preserve it in operations. The second, an antagonist of the preceding, with respect to adduction and extension of the foot, is remarkable, in that its insertion on the internal and inferior surface of the internal cuneiform bone allows of its being preserved in the tarso-metatarsal amputation, whilst we necessarily sacrifice it in Chopart's operation. The third, fixed on the tubercle of the scaphoid, after gliding beneath the lesser tuberosity of the calcis, concurs with the long peroneal on the one hand, and is its antagonist on the other. We have already observed that it entered into the formation of an eminence, which must not be mistaken for that of the scaphoid. We divide it, in separating the foot, in the articulation of the two rows of tarsal bones. It is true, that, its adherences beneath the astragalus and the calcis being preserved, its action remains the

same; but this is an inconvenience, as there is no longer any thing on the dorsal surface to counterbalance it.

The *arteries*, continuations of the posterior tibial, are the *internal* and *external plantar*. The first, much smaller than the other, soon divides into two branches, separated from the skin by the short adductor muscle, and having the internal plantar nerve, tendon of the flexor proprius, and that of the flexor communis between them. Unless anomalous, the internal plantar is never of sufficient size to cause serious hemorrhage; nevertheless, it almost always requires a ligature after amputation of the foot. The second, the real continuation of the common trunk, examined at the calcaneal vault, at first crosses the superior surface of the adductor pollicis muscle, subsequently that of the short common flexor; accordingly, if we cut on the fissure separating the internal and middle eminences of the foot, we should find it external and beneath the tendons, which run from the leg to the toes, in passing behind the malleolus. Continuing its course outwards, as far as the external plantar fissure, and opposite the posterior extremity of the fifth metatarsal bone, it lies above the short flexor, external to the plantar nerve, and beneath the musculus accessorius, the calcaneo-cuboidal ligament, and tendon of the peroneus longus. Of its two terminating branches, one, pursuing the same direction, becomes superficial, and ramifies in the short flexor muscle of the little toe, or the subcutaneous tissue; the other winds inwards, and slightly forwards, reaching the posterior portion of the first inter-osseous space.

The short and long flexor muscles, as well as the lumbricales, are below, whilst the tendon of the peroneus longus, ligaments, and the origin of some of the inter-ossei, are above, the oblique abductor pollicis behind, and the transversus pedis in front. It is here that it unites with the dorsal artery of the foot, and that the plantar arch terminates, uniting the anterior and posterior tibial arteries in an angle, having the apex in the popliteal space, and the base in the sole and dorsum of the foot; hence, a ligature on any point of one of these two branches would not prevent the blood entering its inferior extremity by means of the other. Consequently, it is always a rule, in wounds of the anterior tibial, to place a ligature above and below the injured point. Does not this disposition equally indicate, that, to cure aneurism of one of the principal arteries of the leg, the ancient is preferable to the modern operation? After amputation the external plantar is the first that must be tied. The *veins*, accompanying the arteries, present no peculiarities distinct from the latter.

The *lymphatics* of the superficial layer, very numerous, communicate with those of the dorsal region by the margin of the foot, and pass to the tibial regions, running behind the two mal-

leoli. Those of the deep layer, much fewer, follow the blood-vessels to the calcaneal fossa. Thus, inflammatory affections of the skin and cushion, separating it from the aponeurosis, easily transport themselves, by the former, over the dorsum of the foot, and to the external as well as internal surface of the leg, whilst the latter can only propagate the diseases of the deep parts to the posterior tibial region.

Nerves.—All are derived from the posterior tibial. Before bifurcating to produce the two plantar, it habitually gives off a fasciculus of filaments, which, most commonly arising by a single trunk, ramify in the subcutaneous tissue of the heel, and concur in rendering inflammation of this region exceedingly painful. At first mingled with the tendons of the flexors and tibialis posticus, the plantar nerves soon separate to pursue a different direction.

The internal, running between the branches of the corresponding artery, and on a rather more superficial plane, crosses the inferior surface of the tendons of the flexor communis and flexor proprius, before arriving beneath the short flexor of this latter toe. Consequently, much nearer the integuments, its distribution is similar to those furnished by the median to the thumb.

The external, also following the artery, on its concave or inner side, gives from its convexity several branches, which cross this vessel to divide in the external muscular portion, and a subjacent elastic cushion. Plunging with the arteries, it runs to the foot like the median in the hand, and its branches, in wounds, are always injured before the vessels. We may imagine, from the size and number of the filaments which they give to the subcutaneous tissue, the violence of the neuralgic pains sometimes manifested in the sole of the foot, as well as those accompanying all acute diseases of this region.

The *texture of the sole of the foot* is remarkable from so many causes, that I shall be pardoned for reverting to it, more particularly with respect to the suppuration succeeding inflammations. In consequence of the thickness of its epidermis, pus formed beneath produces considerable separation of parts below, and sometimes ulcerates the dermis before escaping externally, as occurs daily in the heel from over-walking. The filamentous or flocculent condition of its subcutaneous tissue shows, why its inflammations so easily assume the anthracious character, instead of spreading in patches, as in the leg. Deeper seated, and, as it were, imprisoned in one or other of the three aponeurotic sheaths, suppuration there confines itself to dissecting the muscles, nerves, and vessels; but the interstices presented by the fascia in front render extension towards the skin so easy, that it is quickly propagated thither. The tendons of the peroneus longus and flexors, being covered with syno-

vial sheaths, explain, with the nerves and vessels, how it spreads so rapidly behind the malleoli, subsequently to the rest of the leg, accounting for all the dangers which may ensue.

The *skeleton*, constituted by all the tarsal and metatarsal bones, is particularly interesting with respect to its articulation.

At the external margin, we meet, from the heel towards the little toe, firstly, the external and posterior eminence of the calcis; secondly, the termination of the peroneo-calcaneal gutter; thirdly, below and at about an inch in front of the malleolus, the tuberosity or external crest of the calcis, separating the tendons of the two lateral peronei muscles; fourthly, at about fifteen lines nearer the toes, the posterior prolongation of the fifth metatarsal bone; fifthly, a notch or space, which separates this eminence from the peroneal crest of the calcis, and which, divided into two equal portions, allows of our falling on the union of the cuboid with the os calcis; that is to say, that this articulation lies at about seven or eight lines from either of these tuberosities.

The inner border of the foot, comprehending a larger number of articulations, also, presents more eminences and depressions. We here see, firstly, the internal and posterior eminence of the heel; secondly, a large fissure, separating this eminence from the internal malleolus, and continuing the tibio-malleolar gutter; thirdly, beneath the malleolus itself, but only in some individuals, the lesser tuberosity of the calcis; fourthly, some lines more anteriorly, a tubercle, rendered very prominent by turning the external border of the foot outwards, and formed by the head of the astragalus: sometimes this relief is augmented by the tendon of the tibialis posticus, which naturally passes beneath: in some, especially in old individuals, a sesamoid bone is here developed, rendering it still more marked; so that it might easily be taken for the tubercle of the scaphoid, if we did not reflect on the distances separating the latter from the malleolus; fifthly, the internal and inferior eminence of the scaphoid bone, placed at about an inch in front of the malleolus; separated from the preceding by a deep fissure, conducting, externally and anteriorly, into the astragalo-scaphoidal articulation, it is a guide in amputation of the foot, according to the method of Chopart; sixthly, a little further, at about six or eight lines, we meet with rather a shallow depression, frequently distinguished with difficulty, corresponding to the joint of the scaphoid and internal cuneiform bone; seventhly, an inch still further, we find the anterior inferior belly of the inner cuneiform bone, subsequently the internal projection of the posterior extremity of the first metatarsal bone, and between these two eminences an indistinct fissure, more marked, however, than the preceding, and conducting to the joint.

We must remark, that these latter objects are more easily

felt from before backwards than in following the course we have pursued, and that they are distinguished with greater facility nearer the plantar than the dorsal surface. The most convenient, and for that reason the best, method, as it is also certain, and is not prevented by deformity of the parts, consists in drawing a transverse line from the projecting and posterior portion of the fifth metatarsal bone to the inner border of the foot. This falls on the inner cuneiform, at two or three lines in front of its articulation with the scaphoid. The first cuneio-metatarsal joint exists at nine or ten lines in front.

The *dorsal surface* of the foot also presents certain characters, which may assist in determining the seat of some articulations; particularly those traversed in Chopart's amputation. In adduction and extension, the external excavation of the instep is limited, posteriorly and externally, by the peroneal malleolus; below, and externally, by the calcaneal crest, and in front by two other projections. One, external, at twelve or fourteen lines in front of the corresponding malleolus, is formed by the external and superior surface of the head of the calcis; the other, internal, is the head of the astragalus. This latter is separated from the tibia by an interval of nearly an inch, and by a constriction, upon which the knife should not be placed, when we would disarticulate the foot at the union of its two rows of tarsal bones, found immediately in front of these two eminences, and at about two inches behind and internal to the posterior extremity of the fifth metatarsal bone.

As the *astragalus* is embedded in the posterior cavity of the *scaphoid*, we must, to penetrate between them by their internal side, at first follow a line passing outwards, towards the posterior extremity of the last metatarsal bone, and continue by a half circle, with its convexity directed forwards. The tibio-tarsal synovial membrane, sometimes prolonged very far forwards, runs the risk of being wounded, and the head of the astragalus being thus denuded, the surgeon would be obliged to remove it with a saw, after the incision had been carried too far backwards.

The surfaces of the calcis and cuboid being directed outwards and slightly forwards, if the incision prolonged the preceding half circle backwards, it would fall on the astragalo-calcaneal fissure, instead of opening the calcaneo-cuboidal articulation; a mistake the easier made, as this excavation appears to be the result of the astragalo-scaphoidal joint; but it is sufficient to recollect what has been said of the external border of the skeleton to escape this error. If, instead of the head of the astragalus, we imagine a plain surface, similar to that of the calcis, these bones would form two planes, inclined

so as to circumscribe a triangle, in the summit of which we find the postero-external point of the scaphoid, and the postero-internal angle of the cuboid. It is, therefore, in front of this triangle that the division of the soft parts should take place. Arrived at the bottom of the sinus, the knife divides the very strong ligament filling a portion of the astragalo-calcaneal excavation, also prolonged over the scaphoid and cuboid. We must then change the direction of the instrument, and conduct its edge outwards and forwards, to destroy the dorsal calcaneo-cuboidal ligament, and the tendon of the peroneus longus.

A very frequent anomaly occurs from the osseous condition of the calcaneo-scaphoidal ligament; we may imagine the difficulty that it would cause in amputation according to Chopart's method, and that it would be better, in such cases, to use a saw, than to attempt to break it by violent efforts.

The tarso-metatarsal surfaces, being more numerous, are also more complicated. The corresponding surfaces of the cuboid and fifth metatarsal bone are oblique inwards and forwards, in the direction of a line which from the posterior part of the last metatarsal bone would fall on the phalangeal extremity of the first. The union of the cuboid with the fourth metatarsal being nearly transverse is sometimes about half a line posterior; that of the third cuneiform and metatarsal is, also, nearly transverse, but sometimes a little anterior to the preceding. The first tarso-metatarsal articulation is situated at three lines nearer the toes. Here the surfaces are oblique in two directions, from above downwards, and before backwards, from within outwards, and from behind forwards, in the direction of a line which would run externally over the middle portion of the fifth metatarsal bone. If we forget this double direction, we may essay for a long while before we penetrate between the two bones. The second metatarsal bone, which surpasses the first by three or four lines, and the third by an inch, or an inch and a half, is, posteriorly, as it were, embedded in the mortise formed by the three cuneiform bones, which is larger above than below, and in front than behind. Its internal wall, constituted by the internal cuneiform, from three to four lines long, is very slightly oblique forwards and inwards; the external, from one to two lines long, rather oblique forwards and outwards, is sometimes wanting; finally, its posterior wall is plain and quite transverse.

All these articulations are covered by the dorsal ligaments; the first metatarsal, for example, receives one from the internal cuneiform, covering all the internal superior portion; the second receives one from each of the three cuneiforms; and the three succeeding receive each one, either from the third cuneiform, or from the dorsal surface of the cuboid. After the division of

these various bands, the bones are still maintained by much stronger and denser ligaments; these are the fibrous masses, which exist naturally between the lateral surfaces of the three cuneiforms and of the corresponding metatarsals. The most important is that existing between the first cuneiform and the second metatarsal. It is indispensable that we should well understand the arrangement of this ligamentous apparatus, and divide portion by portion, in tarso-metatarsal amputation, if we would avoid difficulties and painful stretching. We should, also, be aware that, either from disease or old age, the second metatarsal bone is sometimes anchylosed in the notch of the three cuneiforms, and that then we should be obliged to use a saw. In individuals under fifteen years of age, ossification being still incomplete, we do not need so much precaution, and the instrument may easily cut across the cartilages.

M. Zeigler has found the posterior tubercle of the fifth metatarsal bone so much prolonged towards the calcis, that it represented a styloid process, from six to eight lines in length, causing great difficulty in entering the articulation by its external portion. M. Blandin mentions a subject who had four cuneiform bones, instead of three. In a dead body, upon which I showed the operations to my class in 1829, the anterior surface of the cuboid represented a triangular sinus, of four or five lines deep, and there was great difficulty in separating the metatarsal bone; both feet were alike in this respect, and the subject was not more than eighteen years old. M. Blandin, also, states that he has met with complete anchylosis of nearly all the tarsal bones; and I have myself observed it between the first cuneiform and first metatarsal.

In amputating the metatarsal only, we have, in the first place, the advantage of preserving greater length and breadth to the foot, the termination of the tibialis anticus, as well as that of the tibialis posticus, peroneus tertius, and even peroneus brevis. By Chopart's method, on the contrary, all these tendons are divided, the foot is much shorter, the wound is considerably larger, and immediate union consequently less easy and certain.

The synovial surfaces of the cuboid and cuneiform bones, being continuous posteriorly with that of the scaphoid, led M. Blandin to conclude that the tarso-metatarsal amputation would be more dangerous than the operation proposed by Chopart. But this continuity of the synovial membrane is not constant, and that of the astragalus with the calcis, or (as I once saw) with the tibia, would, I think, give rise to equal danger in this respect. The bones of the tarsus being united by strong and numerous ligaments, touching by plain surfaces, enjoy no other motion than that of very obscure gliding; with the exception of the astragalus, which turns very easily in the

posterior cavity of the scaphoid, on the one hand, and on the superior articular surface of the calcis, on the other. Hence, they are scarcely ever luxated. Short, thick, of a soft and spongy texture, they are only capable of being crushed, and not fractured, by indirect causes. Those of the metatarsus entering into the class of long bones, forming a kind of frame or vault, the concavity of which is never exactly applied to the ground, appear, on the contrary, susceptible of being broken in various points; their luxation, which might have been considered impossible, has, nevertheless, been observed, MM. Dusol and Robert having each related an example. The multiplicity of the articular surfaces, with the strength of the ligaments, muscles, and tendons, accounts for the difficulty experienced in reductions.

Every thing in the skeleton of the foot is for solidity, scarcely any thing for mobility. Though it forcibly resists physical lesions, the same is not the case with vital diseases. The numerous synovial surfaces, the abundance of fibrous tissue, the spongy nature of the bones, their depending position, and the pressure which they habitually support, all favour the developement of acute or chronic inflammation, caries, and necrosis. Parallel, mutually supporting each other, the metatarsal bones, when fractured, require but little attention.

The heel, the heads of the metatarsi, and the external border of the last of these bones, being the only supports in the upright position, the weight of the body, transmitted by the leg to the superior surface of the astragalus, continually presses, so as to efface the plantar concavity. Much deeper internally than externally, this curvature renders it necessary to raise the knife against its tibial border, in order to give sufficient thickness to the flaps of the soft parts, in amputation, particularly, when this operation is performed near the tibio-tarsal articulation. On the other hand, enclosing the vessels, nerves, and soft parts of most importance, it shelters them from pressure, and accommodates the foot to the inequalities of the earth. Thus individuals, who only possess this in a small degree, are quickly fatigued by walking or standing. It also causes the os calcis, considerably prolonged backwards, pressed from above downwards by the leg, and drawn from below upwards by the tendo Achillis, to break very easily. We might imagine, from the strength of the muscles of the calf, that, in such a case, the posterior fragment would be drawn very high up; but the plantar aponeurosis and fibrous layers offer so much opposition, that, in some cases, there is scarcely any displacement. In a word, this is a fracture, which, in several points of view, resembles that of the patella or olecranon.

The metatarsal bone of the great toe, considerably enlarged at its two extremities, very concave on its internal and

inferior surfaces, has imposed some rules of practice, which it may be useful to repeat.

For example, we do not amputate in the first metatarso-phalangeal articulation, because we prefer cutting through the middle of its body. On the other hand, when it is itself diseased, we should not, unless we are absolutely obliged, disarticulate it posteriorly, as then the first cuneiform would form a very inconvenient projection on the inner border of the foot after cure. If this last rule may be maintained with advantage, it is not so with the first. Le Dran, Richerand, and most of the modern authors, would be right, if there was nothing but theory required, but the head of the first metatarsal bone furnishes a too important point of support to the foot in walking and standing for us to sacrifice it, unless we are absolutely obliged. The extent of the wound, the necessary section of the bone, the importance of the soft parts to be divided, the difficulty even of the performance, all oppose the possibility of drawing a comparison between the two operations.

Although eversion of the tarsus does not result so frequently as M. Blandin imagined, since it did not appear in either of the ten patients upon whom I operated, the accident may occur. In addition to the reasons which have led to the adoption of the oblique section of the bone, in place of its tarso-metatarsal disarticulation, as more prompt and easy, there is the danger of the inflammation spreading from the first cuneiform to all the other synovial surfaces of the tarsus. The removal of this bone preserving the toe, an operation suggested by necessity to M. Barbier, in a case of compound luxation, although possible, since it has succeeded in more instances than one, is, nevertheless, far from presenting the same advantages as in the thumb; it is, therefore, doubtful whether practitioners will consent to substitute it for the preceding, with the only view of preserving so unimportant an organ as the great toe. We may apply here that which has been said of the metacarpal bone of the thumb; only, as the first metatarsal bone is almost immobile, when we do not perform a mere disarticulation, but an oblique section in its length, the process, which consists in, at first, cutting the flesh from before backwards, between the two first toes, to make the internal flap, after having sawed through the bones, would not present any advantage, and the two others, which have been indicated for the thumbs, are nearly the only methods employed. Exostosis, so frequent in the dorsal region, in individuals of advanced age, pushing the extensor tendon to the right or left, might always be removed without danger, if it were not sometimes too near the synovial membrane of the joint, and if inflammation could not extend over the whole dorsum of the foot. As to the other metatarsi, the last is easily removed by the various methods employed for disarticulation of the little toe, in addition

texture, than the corresponding portion of the fingers, explains the diminished pains produced by their inflammations, which proceed as true phlegmon, and frequently terminate in abscess.

The circumference of the *nail* is here equally the seat of whitlow, and it is particularly to these superficial or deep inflammations that we give the name of *onychia* or *paronychia*. This latter, usually produced by what is called "*the nail growing into the flesh*," should be carefully distinguished from that which Mr. Wardrop has described under the name of *onychia maligna*. It depends upon the pulp of the great toe, almost the only one which can be affected, pressed in the shoes from below upwards, and on its sides, mounting over the edges of the nail, which then appear to bury themselves in the soft parts; a phenomenon, also, favoured, says M. Richerand, by the custom of some persons of keeping the nail of this toe very short and rounded at its angles. As the pressure is not equal on both sides, there is only one edge of the nail implicated. According to most surgeons, it is the inner in which we most frequently perceive ulceration, whilst, on the contrary, it is the external, according to M. Guillemot.

Anatomy indicates that, by introducing a piece of lint beneath the border producing the disease, in order to raise it at the same that that the flesh is pressed away, we may sometimes remove the disease. It, also, points out that the treatment recommended by Fabrice is advantageously replaced by the plate of steel proposed by Desault, of lead, as recommended by Richerand, or by the repeated application of a warm plate of silver, as practised by Moreau of Tours. But it is evident that, by excising the vegetations, as advised by Brachet, and favouring the formation of a solid cicatrix, by the repeated application of the potassa fusa, we cure it much more quickly and effectually; inasmuch as it is not the nail which has enlarged to injure the soft parts, but, rather, the soft parts which press against the edges. Another method, still more prompt and effectual, consists in the removal of the nail; but, being imbedded by its root and margins in the soft parts, this operation is rendered excessively painful. However, if we take the precaution of opening that which Dupuytren calls the *matrice* of the nail, when we would completely remove it; or divide it into two lengthwise by scissars, one branch of which is rapidly pushed from its free border to its root, when we would only remove the half, we find much less difficulty, and the pain is in reality less than we should at first imagine. To scrape its middle and dorsal portion with a piece of glass, so that its edges, by approximating, cease to press against the flesh,—to remove, by one stroke, from behind forwards, with a strong bistouri, the edge of the nail with the projecting portion of the toe, as M. Baudens has frequently done, are two equally successful methods; but we must not forget that the mechanical lesion is

very frequently merely accessary, and that, after having destroyed it, it is also necessary, in order to obtain a perfect cure, that we should modify the vitality of the soft parts.

Lastly, for all that concerns the skin, nails, subcutaneous tissue, fibrous sheaths, tendons, synovial membranes, vessels, and nerves of the toes, I must refer to the article which treats of the fingers, or of the skin in general. I shall only add, that the dorsal surface of the phalanx of the great toe is sometimes the seat of exostosis, capable of causing considerable embarrassment to practitioners who are not aware of the possibility of its occurrence.

SUPPLEMENT.

M. Nelaton exhibited two preparations to the Anatomical Society, proving what I have said of prolapsus of the rectum: that the three tunics are everted in this complaint, and not the mucous membrane of the intestine alone. Some researches, also, of M. Tessier support what I have advanced respecting the organisation of the articular cartilages, by establishing, that in the normal condition they contain neither nerves nor vessels, and that they exist only by or from imbibition. The transformation of yellow elastic tissue into muscular tissue, announced by me in 1829, 1833, and 1835, is now rendered an undoubted fact, by the observations of MM. Laurent and Thomson.

I have proved the existence of a kind of sphincter of the rectum, discovered by M. Nelaton. It is a fleshy ring, placed at almost four inches above the anus, exactly at the spot where contraction of the rectum above the anal region most frequently occurs. If, after having everted the rectum so that its mucous surface becomes external, we slightly inflate it, we see that this muscle, which M. Nelaton proposes to name *superior sphincter*, is formed of fibres united into a fasciculus. Its breadth is six or seven lines anteriorly, and about an inch posteriorly. It is thickest in front, where the fibres seem collected in the retiring angle, corresponding to the union of the first with the second curve of the intestine, whilst, posteriorly, they are disseminated over its convexity.

The functions of this sphincter are,—

First, To arrest the feculent matter above the inferior enlargement of the rectum, into which it only descends a short time before defecation.

Secondly, During defecation, it breaks up the stercoraceous matter, and prevents its reflux into the colon.

Thirdly, After division of the external sphincter in the operation for fistula in ano, extirpation of the extremity of the rectum, &c., the destruction of the portion of this canal during vesico-vaginal fistula, it would in a great measure oppose the continual involuntary passage of the excrement. We then observe, in this muscle, a thickness, which accords with its increase of function.

On the other hand, the superior sphincter may be the seat of several diseases. Thus valvular constriction is most frequently

only hypertrophy of this muscle. The stoppage of angular foreign bodies in the rectum ought much rather to be referred to the eminence formed by it in the cavity of the intestine, and to its spasmodic contraction, than to the obliquity of the orifices of the follicles, which in no wise differ here, says M. Nelaton, from those which we remark in other points of the rectum. Finally, invagination, so frequently observed in young children, commences here.

I do not think that we must consider all the attributes bestowed on this muscle by M. Nelaton as demonstrated; that it, for instance, performs an important part in defecation; but, I believe, that, to a certain point, it is supplementary to the inferior sphincters, and is the cause of certain contractions, &c. of the rectum. Posteriorly, its fibres appear to me to interlace, and fix on the anterior surface of the sacrum.

The same anatomist has seen, as also have I, that fibro-cartilages, analogous to those in the knee, exist in the rudimental state in many other articulations where they are not generally admitted to be; in the metacarpo and metatarso-phalangeal articulations in particular.

We are indebted to M. Thomson's dissections for many important discoveries, particularly in aponeuroses and muscles, several of which I have myself verified.

From his works there arise many important questions in general and philosophical, as well as descriptive, anatomy, together with results applicable to surgery. Under the first head there arise three considerations: first, that fibrous and cellular tissues, primitively distinct, are never transformed one into the other, that the first is constantly presented in lines, whilst the latter always consists of lamellæ; secondly, that the muscles of the abdomen all interlace, and that the two extremities of their fibres are always attached to bones; thirdly, that the aponeurosis and muscles are one, and that the transformation of one into the other is as easy as frequent. Under the second head we find a new description of the abdominal parietes, perinæum, bladder, and rectum. Under the third we must consider the value of these notions, relative to herniæ, abscesses of the perinæum, &c.; but, as it is not necessary to confine ourselves to the first division in a treatise on surgical anatomy, I shall depart as little as possible from the plan of the rest of this work. I, therefore, enter at once on a detail of the descriptions, allowing to each the surgical considerations which, in my opinion, belong to it. The general ideas will be intermixed with the necessary interpretations.

CHAPTER FIRST.

ABDOMINAL PARIETES.

SECTION FIRST.

SUBCUTANEOUS FASCIA.

THE layer which I have described as fascia superficialis, or, rather, subcutaneous fascia, existing over the whole surface of the body, comprehends three divisions, which I have often confounded, but which M. Thomson considers distinct, incapable of transforming one into the other. The first, which I call *areola,* he calls adipose tissue; the second, which I name *proper superficial fascia,* he calls common superficial fascia; the third, which he calls deep superficial fascia, is my *supple and lamellous cellular tissue,* between the common fascia superficialis and the aponeuroses.

In the abdomen, as elsewhere, the two layers of the superficial, or, rather, subcutaneous fascia, are separated by soft, thin, and elongated adipose cellules, whilst, beneath the skin, the fat is hard and granulated. There also, as elsewhere, M. Thomson conceives that these fasciæ are independent of the cellular tissue, and that fat and infiltrations isolate them in a remarkable manner, instead of destroying them as is generally considered. This last fact is, in my opinion, very correct. With regard to the want of continuity of that which he calls the *linea* or *fibrous system* with the *lamellous* or *cellular system,* or the impossibility of their transforming one into the other, I am not as yet convinced. I have so frequently traced fibrous bands as far as the dermis, I I have so frequently followed aponeurotic prolongations into cellular layers, where they become insensibly lost, that I consider myself authorized in maintaining what I have already said on this subject. In a word, the following is proved by dissection relative to subcutaneous fascia.

The superficial or subcutaneous fascia has bony attachments, like the other aponeuroses and muscles; it consists of two lamellæ, one superficial, common to all the body, the other deep-seated, limited to certain regions.

The *common* or *superficial layer* is formed of transverse fibres, arising from the spinous processes of the vertebral column by tendinous prolongations. Attached in front to the median line, most distinct in fat individuals, this layer envelopes the scrotum and penis, and is neither fixed to the femoral arch nor to the iliac crest. Corresponding by its position and attachments to the cutaneous muscle of animals, it is separated from the deep fold in the scrotum, and the labium majus by the dartos.

The deep layer of the subcutaneous fascia of the abdomen, attached to the spinous processes of the dorsal and lumbar vertebræ and all the crest of the ilium, descends in front of the groin. It there covers a triangular space, bounded below by the trunk of the saphena vein; internally, by its attachment to the deep layer of the fascia lata, as far as the external border of Gimbernat's ligament; externally, by a line corresponding to the inner border of the superior sixth of the sartorius muscle. Lining Gimbernat's ligament, and becoming attached to the inner portion of the crest of the pubes, it sends a sheath to the cord and testicle; re-mounting towards the median line, it forms the deep aponeurosis of the penis, or a sort of sheath which is imbedded in the dartos, because the fibres constituting it permit those of the dartos to pass across their interval, to fix on the aponeurosis of the external oblique. Perforated for the passage of the lymphatics, the inguinal portion of the deep layer of the subcutaneous fascia, supporting or enveloping the superficial glands of the groin, explains, by its internal and inferior attachments, the reflected direction usually presented by crural herniæ. Separated from the common layer by flat adipose tissue, perfectly distinct from the lobulous fat situated beneath the skin, it contains the external epigastric artery, whilst the vein traverses it to proceed to the cutaneous surface of the common fascia.

The deep layer *of the subcutaneous fascia of the thigh* is attached, superiorly, to the iliac crest, and the external half of Poupart's ligament. Its fibres pass across the interval, between the fibres of the deep layer of the subcutaneous fascia of the abdomen. In its inner half, they ascend above Poupart's ligament to become continuous with the deep process of the subcutaneous fascia of the abdomen by means of a kind of interlacing. More internally, they are attached to the subspinal crest of the pubes, and towards the perinæum to the ischio-pubic ramus. Opposite the crural canal, this layer is situated in front of the superficial glands of the groin, which are thus imbedded between the superior portion of the deep layer of the subcutaneous fascia of the thigh, and the femoral portion of the deep layer of the subcutaneous fascia of the abdomen.

On the lateral limits of the ano-perinæal region, that is to say, the internal posterior and superior portion of the thigh, we see it fixed on each side. First, on the inferior margin of the true pelvis, that is, on the external lip of the descending branch of the pubes, and ascending of the ischium; secondly, on the internal lip of the tuber ischii, in its two anterior thirds; thirdly, over the whole perinæal or inferior border of the great and lesser sacro-sciatic ligaments; fourthly, on the border and summit of the coccyx. This aponeurosis is composed of fibres, directed almost parallel to the axis of the thigh. Terminated towards their superior extremity by fan-shaped expansions, imbricated one on the other, stronger posteriorly than in front, and still

more so towards the middle of the inferior opening, they are slightly elastic, white, less silvery, and more opaque than the fibres entering into the composition of the superficial layer. Fixing on the inferior border of the true pelvis, they interlace with the tendinous attachments of the cutaneous sphincter ani and dartos, so that, without attentive examination, we should be led to imagine that the layer formed by them was continuous across the perinæum, whence many errors in the dissection of these parts. We must not forget that, in the inguinal region, we also observe fibres parallel to the axis of the thigh, more delicate and transparent, but less elastic, than the foregoing. These are continuous one with the other, and the change in the characters of their fibres varies with the region. Towards the groin, where there is most motion, they become more elastic, opaque, and voluminous.

SECTION SECOND.

DARTOS.

The dartos is not continuous with either layer of the subcutaneous fascia; its septum is not fixed on the raphe of the spongy body of the urethra. It is an organ of itself, with well-defined attachments, and perfectly fleshy in most mammiferous animals. Constituting in man a tissue, intermediate to tendon and muscle, it is sometimes endowed with great elasticity. There is a dartos for each side; its inferior or principal attachment occurs in the whole extent of the ischio-pubic branch. Superiorly, it is attached to the internal half of Poupart's ligament, and to the two pillars of the inguinal ring above the internal pillar. Towards the abdomen, its fibres pass between the fibrillæ constituting the deep layer of the subcutaneous fascia, as if to interlace with the aponeurosis of the external oblique, and continue with the fibres of the rectus muscle.

Each dartos makes a separate sac for the testicle and cord of the corresponding side. Their approximation constitutes the septum of the scrotum. Superiorly, it forms the superficial portion of the *suspensory ligament* of the penis. The superficial arteries of the perinæum, arising from the ischiatic artery, ramify between the two layers of the septum. Such is the case with the superficial branch of the internal pudic artery. The two dartos, thus approximated, are enveloped by the common subcutaneous fascia, whilst each dartos is invested, internally, by a prolongation of the deep subcutaneous fascia of the abdomen.

This arrangement explains why the urine, coming from the bulbous portion of the urethra, may arrive in the penis and under the integuments of the abdomen.

I have formerly said that this membrane is sometimes composed of supple, wrinkled, parallel, undulating, villous, soft, fibres, presenting, in a word, all the characters of those of the stomach, where the œsophagus spreads out upon this viscus; so that, if I dare give my opinion upon this subject, I should say, that it is the nature of cellular to become transformed into fleshy tissue; but I must not here discuss a point of general anatomy.

When we have perfectly isolated them from the surrounding tissues, on exposing the preparation to a current of air, the lamellous cellular tissue, even the strongest aponeuroses, dry rapidly, whilst the dartos continues humid for a long period. If we preserve the preparation in acetate of alum, the aponeurotic fibres harden; those of the dartos, excepting at their extremities, preserve their flexibility like muscular fibres; if, after having thus preserved the preparation, we put it for some days in pure water to extract the salt, and again dry it, we observe the same phenomena as when fresh. These are peculiarities subject to dispute; but they support the other proofs of the muscularity of the dartos.

The ilio-scrotal nerve is entirely lost in the dartos, which receives arterial branches from four sources: from the two external pudic, the perinæal branch, the ischiatic, and from the superficial perinæal branch furnished by the internal pudic. The greater number of these vessels are lost in the tissue of the dartos. In serous inflammations, the tegumentous and fibrous portions are separated from each other, and thus rendered more apparent; but they are never themselves infiltrated by serum. This concurs in assimilating the fibres of the dartos with muscular and aponeurotic. Besides, we may trace the abdominal attachments of the dartos towards the median line, across the intervals of the aponeurotic fibres of the oblique and transverse muscle, nearly into the terminal expansions of certain fleshy fasciculi of the rectus muscle; and we may see, externally, the continuity of these fibres with those of the tendon of the obliquus externus of the same side.

Finally, the dartos enjoys all the properties of muscle; it contracts under the influence of cold, of venereal erethismus, &c., &c.; its action is paralysed by hydrocyanic acid, and it is sometime before it recovers its contractile power. Thus, exact observation leads us to the conclusion of ancient anatomists, who have called the dartos the suspensory muscle of the testicle.

Its colour is as vivid as that of the muscles of the small intestines, and its fibres are not more delicate than those of the trachea and internal ear.

Its laminæ have hitherto been wrongly considered the result of stretching, or pressure, exercised on the lamellous cellular tissue by hernial tumours.

SECTION THIRD.

VENTRIER.

A rudiment of the elastic belly-band of mammiferous animals exists in the human body of both sexes. This consists of a band of fibres, flattened from before backwards. Implanted below, at two inches beneath the symphysis pubis, on that portion of the fascia lata placed opposite the gracilis muscle, it is attached, superiorly, to the inner pillar of the ring, from its upper angle to the median line.

This band, sometimes elastic, lying behind the abdominal attachments of the dartos and deep layer of the subcutaneous fascia of the abdomen, covers the spine of the pubes and the internal half of the external inguinal ring. Thus constituting a kind of covering, it throws the spermatic cord on the external pillar.

Hence, we should not place ourselves between the legs of the patient to reduce inguinal hernia, as the approximation of the thighs relaxes it, whilst it strongly constricts the ring during their separation.

SECTION FOURTH.

APPLICATION TO HERNIÆ.

It results from the preceding:—

First, That every inguinal hernia, as yet contained in the canal, will have six investing membranes: skin, subcutaneous adipose tissue, superficial layer of the subcutaneous fascia, abdominal portion of the deep layer of the subcutaneous fascia of the thigh, dartos, deep layer of the subcutaneous fascia of the abdomen.

Secondly, That every scrotal hernia is enveloped by six membranes: skin, subcutaneous adipose tissue, superficial layer of the subcutaneous fascia, dartos, deep layer of the subcutaneous fascia of the abdomen.

Thirdly, That every umbilical hernia will be covered by four membranes: skin, subcutaneous adipose tissue, superficial layer of the subcutaneous fascia, deep layer of the subcutaneous fascia of the abdomen.

Fourthly, That every crural hernia will have six investments: skin, subcutaneous adipose tissue, superficial layer of the subcutaneous fascia of the thigh, superficial glands of the groin with their vessels, the fat through which they ramify, and the femoral portion of the deep layer of the subcutaneous fascia of the abdomen.

SECTION FIFTH.

CRUCIAL FIBRES (FIBRES EN SAUTOIR).

The fibres which cross the anterior surface of the aponeurosis of the external oblique, derived from the aponeurosis of the opposite side, are naturally divided into two classes. Having crossed the superior border of the inguinal ring, some wind round the inferior border of the external pillar, to attach themselves on the inner portion of the supra-pubic crest, investing the crural surface of Gimbernat's ligament, which they concur in forming. The others limit the superior separation of the two pillars, reach the anterior surface of Poupart's ligament, wind round its inferior border at its external third, and ascend between it and the iliac fascia, ultimately, to become attached to the internal border of the crest of the ilium.

These fibres in inguinal hernia are the principal cause of constriction; for the more those attached to the pubes are pushed upon by the hernia the more the two portions surrounding the neck of the sac tend towards approximation. The knowledge of their disposition would even allow of our founding a new method of applying the taxis. Passing as far as the spine of the pubes, in raising the neck of the tumour upwards and inwards, the thumb may, in fact, stretch these fibres, converting an elliptic into a rounded ring, and thus make room for the return of the viscera. The second portion of these fibres, being attached to the crest of the ilium, serves to stretch Poupart's ligament during flexion of the thigh, when the abdominal muscles act; but if we also flex the trunk, we relax them.

SECTION SIXTH.

COLLES'S LIGAMENT.

That portion of the external oblique coming from the eighth rib constitutes, by its inferior or external border, the internal pillar of the inguinal ring. Arrived at the median line, this interlaces with the corresponding portion of the opposite side, so that the fibres, coming from the right side, remain definitely on the left, inserted, firstly on the whole of the sub-spinous crest of the pubes; secondly, on the spine of the pubes; thirdly, on the internal half of the supra-pubic crest. It consequently occurs from this arrangement, that, in raising the internal pillar of the other side, we observe triangular fibrous lamellæ, limited inferiorly by the bony attachments already described, and internally by the median line.

This portion described by M. Colles as a triangular ligament is unknown to French authors. Filling the angle formed by the external border of the rectus muscle of the abdomen, and the inner portion of the crest of the pubes, it constitutes one of the lamellæ which serve to complete Gimbernat's ligament. It strengthens that portion of the posterior wall of the inguinal canal, placed opposite the external ring; it is the superior border of this ligament which prevents direct inguinal hernia from lying on the summit of the pubes; and it is equally this which, stretched by the contraction of the external oblique, presents a resistant border, against which direct inguinal hernia is constricted by the surrounding tissues. It may be observed in the inner angle of the ring, when the soft parts are removed.

SECTION SEVENTH.

LINEA ALBA AND UMBILICUS.

Concentric circular fibres have been described, to explain the umbilical ring, and longitudinal fibres extending from the xyphoid appendix, as far as the symphysis pubis, to constitute the linea alba. Such fibres do not exist. The linea alba, results entirely from the interlacing of the tendinous fibres of the flat muscles of the abdomen.

In the normal condition, the opening of the umbilicus is lozenge-shaped, and results from the blending of two portions of the same fibres. The presence of hernia converts that into a ring, which, when the viscera are returned and properly maintained, re-assumes its form and normal dimensions. This is always the arrangement, whatever be the size of the hernia.

Herniæ of the linea alba are also easily explained by the assistance of this structure, for when we examine such tumours, we find an appearance of spreading of the recti muscles, although in reality those portions of the muscles corresponding to them are narrower than the portions above and below. The pressure exercised during distension of the abdominal parietes, by the two layers of its fibrous sheath, in these cases gives rise to absorption of the fibrin, and conversion of the muscle into aponeurosis.

This is the manner in which we may explain the lozenge-shaped enlargement of the linea alba.

Poupart's ligament.—The portions of the obliquus externus, arising from the ninth and tenth ribs, furnish tendinous bands inferiorly, which almost all concur in forming *Poupart's and Gimbernat's ligaments.*

These bands inserted definitely on the whole of the sub-pubic, and a portion of the pubic, crests, thus constitute the

true ligament of Poupart, or the internal inguinal ligament of the elder Hesselbach, subsequently, the external pillar of the inguinal ring. The most external ribbon, from three to four lines broad, extending over the anterior superior spine of the ilium externally, does not pass to the pubes, but rather to the thigh, between the sartorius and psoas and iliacus muscles, to seek an insertion on the lesser trochanter. The others only retain the form of a cord in the external half of Poupart's ligament. Before attaching themselves to the internal portion of the crest of the pubes, they spread in a triangle, the femoral plane looking rather backwards, and which constitutes one of the layers of Gimbernat's ligament. Other fibres are inserted on the spine of the pubes; the most internal, which contribute to form the external pillar of the ring, are implanted on the anterior surface of the pubes, from its spine to the middle of the border of the symphysis, that is to say, the whole sub-spinal crest of this bone.

The cord-like form which the external fibres of the external oblique assume, is, on the one hand, produced by the crucial fibres previously described, and, on the other, by certain vertical fibres, constituting the proper aponeurosis of the sartorius, which ascend and interlace with the outer half of Poupart's ligament. As this arrangement has no existence internally, the tendinous fibres of the external oblique spread out to form Gimbernat's ligament. From this description, the portion of Gimbernat's ligament, furnished by the external oblique, appears much longer than is generally supposed. In front, equalling the internal half of Poupart's ligament, it is from six to ten lines long from the pubic crest.

Not a single fibre of the aponeurosis of the external oblique rises posteriorly, to form what M. J. Cloquet has described as the gutter of Poupart's ligament, which, from what this author and I myself have said, must be continuous with the fascia transversalis.

Since the tendinous bands, which form the external pillar, are attached to the sub-spinal crest, at the same time that the internal pillar fixes on the corresponding line of the opposite side, these two, after being separated superiorly, must meet in an acute angle at their termination in front of the pubes; whence the action of the external oblique, aided by the distention of the walls of the abdomen, may approximate the edges so closely as to transform the inguinal ring into a button-hole, and cause constriction by muscular action. The crucial fibres constituting the upper portion of this ring, being submitted to the same action, the three edges may approach or separate by the influence of the muscles, and not only may spasmodic constriction occur, but also narcotics and emetics be very useful adjuncts of the taxis in inguinal hernia.

SECTION EIGHTH.

RECTI MUSCLES.

At its upper three fourths, the internal oblique constitutes a true digastric with the external oblique of the opposite side. Tracing the aponeurotic fibres of this latter beyond the median line, we find some, which interlacing with those of the similar aponeurosis of the opposite side, and becoming fleshy, soon after partly form the internal oblique muscle. Some of them also spread out, towards the commencement of the muscle, to cover the two surfaces of the fleshy portion. After having formed this double or intermuscular investment, these fibres unite, interlace with those of the lumbar aponeurosis, and are definitely attached to the spines of the vertebræ. Other fibres of the same aponeurosis, arrived at the median line, split, embrace the rectus muscle, and again interlace externally, to complete the sheath. Like the preceding, they give origin, some to the internal oblique, others to the transversalis, some also spread out under the form of a fine membrane, between the external and internal oblique muscles, the internal oblique and transversalis, and behind this latter, to form fascia transversalis, or the fascia propria.

A portion of the deep fibres of the aponeurosis of the external oblique, winding towards the median line, curve and interlace with analogous fibres, of the opposite side, form an intersection, become fleshy, and constitute the descending portion of the fibres of the rectus muscle. Arrived at the intersection below, these fibres again become aponeurotic, turn either to the right or to the left, interlace a second time with the deep fibres of the external oblique muscle, to continue with the tendinous fibres of the same or opposite side, according as they are nearer or further from the median line.

If we, in their turn, examine the deep fibres of the aponeurosis of the internal oblique, we perceive that opposite the intersections, they occur from below upwards, interlace with the deep fibres of the aponeurosis of the external oblique, again become fleshy, and constitute the ascending portion of the rectus muscle. These latter arrived at the intersection immediately above, again become tendinous, turn to the right and left, having mingled with the fibres of the external oblique.

Every body knows the costal attachments of the diaphragm; but we have not remarked the delicate fibrillæ, which arrive from the crest of the ilium, under the form of tendinous and fleshy fasiculi, between the digitations of its circumference.

The external or inferior fasciculi of the pectoralis major are implanted on the abdominal aponeurosis; becoming tendinous,

their fibres extend towards the first intersection of the rectus muscle; interlacing with the fibres of the corresponding external oblique, they arrive definitely behind the aponeurosis of that muscle opposite the intersection; curving then from above downwards, they interlace with the other tendinous fibres of the intersection, and finally become fleshy.

Inferiorly, the fibres of the rectus muscle also give origin, by mingling with those of the opposite side, to some parts of importance. Some become tendinous in traversing the median line, quickly resume their fleshy character, and form the pyramidal muscle. Others, situated more deeply, assemble in a fibrous fasciculus, attached near the symphysis, on the border of the pubis, as far as Gimbernat's ligament.

The fasciculus of the right, with that of the left, form a small triangular ligament, with the base below, already noticed by Breschet. The separation of its two branches with the border of the symphysis circumscribe the entrance of a funnel, prolonged by its apex to the dorsum of the penis, accompanied by a small artery derived from the epigastric. Finally, the rest of the fibres of the rectus fix on the edge of the body of the pubes, or spread outwards to constitute what I have described as fascia transversalis.

The result of the preceding is,—

First, That all the fibres of the rectus muscle are derived from the broad muscles of the abdomen and chest.

Secondly, That the intersections of the rectus arise from the interlacement of fibres of the muscles of the abdomen at those spots, where they become fleshy.

Thirdly, That the external and internal oblique, transversalis, and rectus of the abdomen, with their intermuscular aponeurosis, are only one muscle, having several bodies.

Fourthly, The aponeurotic portions of these muscles are composed of fibres, which, although less methodically arranged, possess a power of resistance equal to that of membrane.

SECTION NINTH.

FASCIA TRANSVERSALIS.

The membranous layer, situated between the purely cellular fold of the peritonæum and the transversalis muscle, and hitherto considered as fascia transversalis, is composed of two distinct layers, one posterior, the other anterior.

The posterior layer is thin, and invests the internal surface of the transversalis muscle, and the inferior portion of the rectus. This is the fold which I have described as fascia propria, M. Thomson calls it *true* fascia transversalis.

The anterior layer, thicker and stronger than the preceding,

to which it adheres only by loose cellular tissue, forms what I have described as fascia transversalis, and is attached, on the one hand, to the pubes and ilium, on the other, to the tendons of the rectus and transversalis muscles, by means of the interlacements of its fibres. This layer, by its resistance, must be considered as essentially constituting the posterior wall of the inguinal canal; the fibres forming it may be classed as internal, external, and anterior.

The first nearly follow the direction of the rectus, and are inserted on the crest of the pubes, an inch or an inch and a half from its spine. An inch and a half or two inches above, they terminate, by the interlacing of their extremities on the posterior surface of the transversalis muscle, an inch or an inch and a half external to the rectus muscle.

The external fibres, parallel to the internal, and on the same plane, descend vertically to the upper border of the crural canal, opposite the femoral vein and artery; there they curve outwards, beneath the spermatic cord and vessels, to accompany the superior border of the ilio-pubic band as far as the iliac crest, where they are inserted. They then constitute at once the internal and inferior pillars of the internal inguinal ring, supporting the commencement of the spermatic cord. Superiorly and internally, we perceive, that after their interlacements with the aponeurotic fibres of the transversalis muscle, each of them becomes continuous with a fleshy fasciculus of the rectus muscle. The anterior fibres are applied in front of the internal and external fibres just described, and with them form angles of about thirty degrees. They are inserted, on the one hand, on the inner portion of the crest of the pubes, to the same extent as the preceding, and appear, on the other, to be continuous with the outer border of the tendon of the rectus; but, by carefully tracing them, we perceive that they proceed from the transversalis and internal oblique muscles of the opposite side. These fibres, hitherto undescribed, according to Thomson, often interlace with the fibres placed behind, and thus oppose the formation of internal inguinal hernia.

It therefore results that as they have well marked insertions, the recti and transversalis muscles, whence they are derived, being contracted, they are themselves stretched, and oppose the formation of herniæ across the posterior wall of the inguinal canal. This can easily be demonstrated upon the dead body.

The peritonæum and fascia propria, being reflected, we expose the bands of which I have spoken. Stretched by the action of the recti and transversalis muscles, they resist the pressure of the finger, and present a smooth edge, corresponding to the upper pillar of the internal ring. The portion of the transversalis, lying in front, merely adheres to it by loose cellular tissue, excepting at an inch and a half or two inches

above the crest of the pubes, where they interlace. If we apply the finger immediately external to the vertical border of the internal ring, the peritonæum may be easily depressed, so as to represent a small hernial sac. Oblique inguinal hernia always occurs thus.

When the recti muscles and the diaphragm contract, the internal oblique and transversalis are necessarily stretched and pushed forwards. The stronger the contraction the more it stretches the posterior wall of the inguinal canal. This wall, plane and resistant, receding, folds the other muscles forwards, separates them from the internal ring, and converts the peritonæum, between these two parts, into an inclined plane, offering no obstacle to the course of the hernia.

The tendency of the internal inguinal ring to open is greater as the trunk is more or less strongly bent upon the lower extremities, during the exertions which may cause a hernia. In fact, in this position, the abdominal cavity being shortened dilates laterally; the ilio-pubic, to which the fibres of the transversalis and internal oblique, which pass forwards and outwards, are intimately attached, relaxing, allows the lower portions of these muscles to distend.

Thus, then, duringflexion of the trunk, every violent effort, such as raising a weight, &c., tends materially to open the internal inguinal ring, and consequently to facilitate oblique inguinal hernia.

SECTION TENTH.

FASCIA PROPRIA.

The fascia transversalis of M. Thomson is formed by a layer of fibres coming from the external oblique of the opposite side on the internal surface of the transversalis muscle, after having traversed the median line; proceeding thus beyond the linea alba towards the flank and iliac fossa, under the form of a thin lamella, it terminates, by arriving on the contour of the pelvic excavation, and the lateral portions of the bodies of the lumbar vertebræ, where it is attached. Another series of fibres, arising between the digitations of the diaphragm, equally concur in forming it, in descending to the crest of the ilium, where they remain after having interlaced with the preceding, producing a membrane. In this manner the fascia transversalis of M. Thomson, which is the same as that I described as fascia propria, lines the whole of the iliac fossa, closes the entrance of the crural canal, where it forms the septum crurale of M. J. Cloquet, all the region of the flank, in a word, all the internal surface of the abdominal parietes, from the pubes to the diaphragm, and from the anterior to the posterior median line. It is separated from

the peritoneum by the small nerves, from the lumbar plexus, by fat, and purely cellular tissue. It is in its substance that we find the epigastric and the origin of the circumflexa ilii artery; its adherences, whether to the fascia iliaca, crest of the ilium, or to the bands forming the crural canal, are never intimate; they, in general, become much stronger, the nearer they approach the median line, or diaphragm.

SECTION ELEVENTH.

OBLIQUE MUSCLES AND APONEUROSES.

Poupart's ligament does not curve upwards and backwards, as is generally described, to continue with the inferior border of the fascia transversalis. An attentive dissection shows, firstly, that there is not a single fibre belonging to the external oblique muscle inserted into the anterior superior spine of the ilium and that of the pubes; secondly, that, behind Poupart's ligament, there is always a strong band confounded with it. This, lying beneath the inferior border of the internal oblique and transversalis muscles, and separated from the iliac fascia by the circumflexa ilii artery and vein, is formed by very transparent fibres, which, arising from the anterior third of the internal lip of the iliac crest, are placed on the iliac fascia, and descend obliquely, downwards and inwards, along the posterior inguinal gutter.

Arrived at the outer side of the iliac artery, these fibres approximate, form a narrower fasciculus, subsequently divided into two orders, some passing in front, others behind the femoral vessels opposite their origin. It next unites, on the crest of the pubes, with Gimbernat's ligament, behind the expansion of the rectus muscle. Its anterior border is attached in its external half to Poupart's ligament. At this point, and especially in front, it receives the internal oblique and transversalis muscles, to which it is firmly fixed by the almost vertical fibres constituting the sheath of the sartorius.

Beneath the anterior superior spine, the internal oblique and transversalis muscles are not inserted, as stated by English authors, on Poupart's ligament, nor, as considered by the French, in a groove of the external oblique. Their fasciculi all arise from the anterior extremity of the internal lip of the iliac crest, by filaments, which are longest as they are most inferior. Reposing on the anterior surface of Poupart's ligament in its external half only, these fasciculi are attached nearly to their whole extent on this surface, by the interlacing of their fibres with those of the proper fibrous sheath of the sartorius. At first sight, they appear to arise from the band; but, carefully cutting the extremity of the fibres of the aponeurotic sheath of the

sartorius, and drawing the fleshy fasciculi towards the median line, we find that each has a tendon attached to the crest of the ilium. However, as by means of the above-mentioned interlacements, their tendinous, origins are firmly attached to the outer half of the ilio-pubic band, it is manifest that they must follow its changes of position.

SECTION TWELFTH.

VARIOUS BANDS OF THE ILIAC FOSSA.

Ilio-pubic band.—When the body is in the upright position, the ilio-pubic band does not describe a straight line between the anterior superior spine of the ilium and the spine of the pubes, but rather a curved, convex downwards.

It is maintained in that position by the interlacing of some of the fibres of its external half with those of the upper border of the fascia lata, with those of the external half of Poupart's ligament, with the crucial fibres of the external oblique, and with the superior extremity of the proper aponeurosis of the sartorius. When the trunk is flexed on the thighs, and reciprocally, the fascia lata and proper aponeurosis of the sartorius, being relaxed, no longer maintain the inferior border of Poupart's ligament and the ilio-pubic band in a state of tension, but allow their angles to disappear. These parts, therefore, may be drawn upwards, by the simultaneous contraction of the two external oblique muscles, until they form a straight line between the two spines, or a curved one, convex superiorly.

After removing the peritoneum, cellular tissue, and fascia propria of the iliac fossa, we observe, externally and anteriorly, a fibrous band, arising from the anterior third of the crest of the ilium, by several fibres, as it were, flattened on the peritoneal surface of the iliac fascia, which it crosses, at first, nearly at right angles. Opposite the anterior superior spine, this appears to be formed of three orders of fibres; first, of those already described, forming an arch as they proceed inwards; secondly, another fasciculus, coming, more particularly, from the spine of the ilium, and which, gradually approaching the preceding, partly interlaces with it towards the middle of the space separating the anterior superior spine of the ilium from the crural vessels; thirdly, the third set of fibres, lying beneath and behind the iliac spine, between the two preceding bands, and passing, inwards and forwards, beneath the last-mentioned fasciculus, to the anterior wall of the crural canal.

After being contracted at the point where its fibres interlace, this band bifurcates, and its upper portion, following the direction of the crural arch, attaches itself near the symphysis to the supra-

pubic crest, spreading out to concur in the formation of Gimbernat's ligament. Its inferior portion, descending, on the contrary, passes behind the iliac vessels, between them and the iliac fascia, which covers the psoas muscle, to fix itself on the ilio-pectineal eminence. It is this ensemble of fibres which constitutes the ilio-pubic band, in this manner spread out like a fan towards the iliac crest, and divided to constitute the iliac opening of the crural canal internally; hence its superior border is concave above, and its inferior below.

Ilio-pelvic band.—The inferior portion of the ilio-pubic band appears to be crossed, at its termination, by a thick fibrous band, flattened on the circumference of the upper opening, from the sacro-iliac articulation, to the anterior portion of the supra-pubic crest. This is the ilio-pelvic band. It is, in its turn, crossed, a little more externally, by the diverging *expansion* of the *psoas parvus;* the fibres of which, passing some above, the others below, terminate the latter on the ilio-pectineal eminence, the former in the crural canal.

It is, likewise, crossed by a series of *pelvi-crural* fibres, which appear to arise from its iliac border, and which, external and anterior to the body of the pubes, terminate, like the preceding, in the posterior wall of the crural canal.

Pubio-crural band, a series of fibres, which, arising from the supra-pubic crest, between the ilio-pelvic and ilio-pubic bands, near their external extremity, pass, under the form of ribbons, externally and downwards, either behind or in front of the femoral vessels, and also terminate in the crural canal. Some of these fibres, examined in the posterior plane, are directed from behind forwards, interlace with some from the psoas parvus, and run, constituting a septum, between the artery and the vein, finally mingling with those of the anterior plane.

SECTION THIRTEENTH.

CRURAL CANAL.

Hence there results a large, nearly elliptical, opening, formed, superiorly, by the abdominal portion of the ilio-pubic band, inferiorly by the iliac branch of the same, and by the other fibres already mentioned. Its internal angle is rounded by Gimbernat's ligament, whilst its external remains acute. The femoral vessels divide it into two unequal portions. Anteriorly, that is to say, towards the thigh, this opening is continuous, by a fibrous expansion, over the whole of the crural canal, under the form of a cone, with its summit terminating on the external coats of the vessels, opposite the entrance of the saphena into the crural vein.

The species of funnel resulting, is, therefore, a cavity interrupted at some points by a fibrous lamella. Its anterior wall is hidden by the falciform process of the fascia lata, whilst its posterior lies on the deep layer of the same fascia. Internally, it appears continuous with the concave border of Gimbernat's ligament; externally, it is, at first, separated from the layer of the fascia lata, which descends over the internal border of the psoas and iliacus muscles, by a considerable quantity of cellulo-adipose tissue. This has hitherto been confounded, sometimes with the fascia lata, sometimes with the fascia propria. As to the ilio-pubic band, it has generally been mistaken for a portion of the iliac fascia, or Poupart's ligament.

SECTION FOURTEENTH.

FASCIA ILIACA.

In the loins, the fascia iliaca, situated more deeply than the ilio-pubic band and the fascia transversalis, is formed of slightly concave fibres, which proceed from the iliac crest, and fix on the superior opening. Towards the thigh, the fibres of the fascia iliaca fix, internally, on the ilio-pectineal eminence, and on the capsule of the joints, as far as the posterior portion of the lesser trochanter. Externally, they are attached in front of the capsule, and on the oblique line, extending from the great to the lesser trochanter, forming a sheath, or the three anterior fourths of a sheath, for the psoas and iliacus muscles.

Superiorly, it suddenly stops, opposite the ilio-lumbar ligament. The sheath of the psoas magnus, which replaces it as far as the diaphragm, is but a portion of the fascia propria.

SECTION FIFTEENTH.

SUBSPINAL CREST OF THE PUBES.

On the anterior surface of the pubes, there is a crest directly uniting its spine to the middle portion of the border of the symphysis. This line, very important, since it constitutes the limit between the thigh and abdomen, has not yet been described. It successively gives attachment, from below upwards, first, to the pubic fascia lata; secondly, to the deep layer of the subcutaneous fascia of the thigh; thirdly, to the reflected portion of the deep layer of the subcutaneous layer of the abdomen; fourthly, to the falciform fold of the fascia lata; fifthly, to certain fibres, which, placed transversely on the anterior surface of Poupart's ligament, are derived from the tendon of the external oblique of the opposite side; sixthly, to some fibres

of the external pillar of the inguinal ring; seventhly, to tendinous fibres, which, in man, give attachment to the pubic cremaster, and to the round ligament in women; eighthly, to the fibres of the external pillar of the opposite side, which is called Colles's ligament; ninthly, to the intermuscular fascia, situated between the internal and external oblique; tenthly, to certain tendinous fibres of the internal oblique of the opposite side; eleventhly, to the intermuscular fascia of the internal oblique and transversalis; twelfthly, to certain fibres of the transversalis of the opposite side; thirteenthly, to the tendon of the corresponding pyramidalis muscle. These parts are attached to the whole extent of the crest, which I shall distinguish as the *subspinal crest of the pubes.*

SECTION SIXTEENTH.

GIMBERNAT'S LIGAMENT.

The fibrous membrane known as Gimbernat's ligament is an organ composed of the extremities of several aponeuroses. Thus, we find, from below upwards, first, the deep fold of the subcutaneous fascia of the thigh; second, the deep layer of the subcutaneous fascia of the abdomen; third, the dartos; fourth, the superficial membrane of the fascia lata; fifth, the pubic attachments of the crucial fibres, constituting the superior border of the external inguinal ring; sixth, the posterior portion of the external pillar of the corresponding side; seventh, the origin of the pubic cremaster in man, and of the round ligament in women, and of the gubernaculum testis in the fœtus; eighth, the attachment of that portion of the internal pillar of the opposite side, which forms Colles's ligament; ninth, the intermuscular fascia of the external and internal oblique; tenth, the intermuscular fascia of the internal oblique and transversalis; eleventh, the tendon of the lower portion of the internal oblique; twelfth, the tendon of the inferior portion of the transversalis; thirteenth, the aponeurosis of the rectus; fourteenth, the pubic attachment of the ilio-pubic band; fifteenth, the origin of the internal fibrous fan, which concurs in forming the sheath of the femoral vessels; sixteenth, the fascia transversalis; seventeenth, the extremity of the supra-pubic ligament.

SECTION SEVENTEENTH.

ROUND LIGAMENT.

The round ligament of the uterus does not pass beneath the inferior border of the internal oblique and transversalis

muscles, but between the inferior fibres of these muscles, which are attached to the crest and spine of the pubes, and those which proceed towards the lower portion of the linea alba.

External inguinal herniæ, in women, are covered by muscular investments, derived from the inferior fibres of the internal oblique and transversalis muscles, dilated, and drawn forwards and inwards.

Since the round ligament passes between the fibres of the internal oblique and transversalis, the intermuscular fasciæ, after giving each a sheath, ascend towards the point through which the ligament passes, to invest the anterior surface of these two fasciæ below, and to fix in front of the ilio-pubic band. The fibres of the internal oblique and transversalis muscles, being more firmly united to this band, thus explain why external inguinal herniæ, in women, do not pass beneath their inferior border.

All that has been said with regard to efforts, during the relaxation of the internal oblique and transversalis in man, from bending the trunk on the thighs, is applicable to the female.

SECTION EIGHTEENTH.

HERNIA BY THE CRURAL SHEATH.

From the above description, the crural canal leaves no natural opening towards the abdomen, through which viscera can escape. It is, however, perforated with holes or small canals for the transmission of lymphatics. The intestines, pushing forwards the peritoneum and fascia transversalis, do not the less penetrate it in the first instance, whatever be the subsequent direction of the hernia.

The anterior and external walls of this funnel send out prolongations, forming septa, by their interlacements between the artery and vein; but nothing separates the vein from the lymphatics and fat. Thus, though the walls of the funnel do not yield, the hernial sac may occupy, not only the part destined for the lymphatics, but, also, that filled by the femoral vein. If the walls of the crural canal resist, the intervascular septum, being weaker, will be pushed between the sheath and the anterior surface of the artery, until it touches the external angle of the canal.

As the anterior and internal walls of this sheath are resistant, the hernial sac, which preserves its form, is larger near the abdominal orifice than the base, and will not, therefore, be constricted towards that orifice. The hernia either occupies the

lymphatic portion alone, the lymphatic and venous, the lymphatic, arterial, and venous portions of the canal, at the same time.

Such a modification of crural hernia may be considered as the most simple or fundamental. Thomson says, that he has seen several examples on the dead body, especially among old persons. When it occurs, we perceive a slight depression at the upper portion of the sheath. The finger then, placed upon the peritoneum covering Gimbernat's ligament, and slid externally, plunges towards the external border of this ligament, covered by the fascia propria. In directing it upwards and outwards, after a course of an inch or an inch and a half, we easily push these membranes in front of the vein, until we are arrested either by the intervascular septum, or by the antero-external angle of the sheath. If the fascia lata and the sheath have not been relaxed, the intervascular septum, placed on the anterior surface of the femoral artery, forms a double layer.

Such herniæ may occur from atrophy of the psoas magnus muscle, the absorption of the fat surrounding the lymphatics, or that portion of the femoral vessels contained in the sheath. It always indicates either the rupture, or, rather, the elongation of the fascia transversalis. M. Thomson declares, that he never found this membrane ruptured.

As these herniæ do not reach the exterior, even in the dead body, they present to the touch a sensation of crepitus, when we depress the integuments towards the crural canal.

It sometimes occurs that, without having ruptured the sheath, the hernia distends the whole of its anterior wall. We then find, in the groin, a rounded tumour, more sensible to the touch than to the eye, surmounted by the inguinal glands, limited, superiorly, by Poupart's ligament, externally by the inner border of the eminence formed by the psoas and iliacus muscles, and, inferiorly, by the internal border of the sartorius.

When, in these cases, we successively remove the skin, the various layers of subcutaneous fascia, Poupart's ligament, and the iliac portion of the fascia lata, we perceive that the form of the tumour is not at all changed; that the depression limiting its superior border remains, produced by the ilio-pubic band, which, not yielding as easily as the rest, constricts its neck. The influence of this band becomes still more manifest, when we compress the abdominal parietes, so as to cause the tumour to project. In this latter form of crural hernia, we find, as in the preceding, that the neck of the tumour extends as far as the intervascular septum, and sometimes as far as the external angle of the sheath. Thomson has observed cases where the superior portion of the septum still remains in its proper situation; whilst the lower portion, having yielded, is dilated, or

pushed as far as the external angle of the canal, allowing the hernia to glide even in front of the artery.

All the anterior wall of the sheath, having yielded, allows the tumour to assume an orbicular form, slightly flattened from before backwards. Its neck is depressed in front, and internally, by the inferior border of the ilio-pubic band; this depression increases from compression of the parietes of the abdomen. The neck of the sac may then be narrower than its body, and consequently susceptible of constriction.

The structure and relations of the sheath show, moreover, how the ilio-pubic band produces constriction in crural hernia. Retained, externally, during extension of the limb, by its interlacement with the vertical fibres of the sartorius, this band is thus fixed by the portion corresponding to the external angle of the sheath. The other fibres, constituting the sheath, are attached to the crest of the pubes, between the two lamellæ of the ilio-pelvic band, in such a manner that the inferior are concave externally, and that every effort tending to push the ilio-pubic band forwards would also tend to raise the ilio-pelvic band, and thus diminish the posterior orifice of the sheath.

The tumour, here giving the sensation of a mere elevation of the deep tissues of the groin, never extends beyond two inches beneath Poupart's ligament, and is rarely more than an inch and a half to two inches wide. As we cannot surround it by the fingers, it may easily be mistaken for a deep lymphatic gland, and the more so, that, being in front of the femoral artery, it is necessarily influenced by its pulsation. May not symptoms of constriction, combined with these characters, be sufficient to identify it, even in the absence of all other signs? And if we had reason to suspect its existence, might we not best remove the obstruction presented by the ilio-pubic band, by flexing the thigh slightly outwards, and relaxing the fibres of the sheath of the sartorius?

A third kind of hernia is that which places the tumour between the external angle of the canal and the intervascular septum. Thomson observed it, in the month of February 1830, in the body of a man, aged nearly sixty, who had two external inguinal herniæ. The hernia on the right side contained the cœcum. When this intestine, which had separated the whole of the peritoneum from the iliac fossa, was removed, he saw the fascia propria, forming a cul-de-sac, between the external angle of the sheath and intervascular septum, folded inwards, capable of admitting the finger, and which descended for an inch below Poupart's ligament. This cul-de-sac placed in front, and external to the epigastric artery, on the femoral vessels, had evidently contained a portion of the colon.

We thus observe, that the crural sheath allows of visceral

projections, without its walls yielding, and that the herniæ, which may incompletely invade one or other cell, may equally occupy its whole extent. Lymphatico-venous hernia is much more frequent than the other. In such a case, we always find the inner cell of the sheath complete; sometimes the intervascular septum resists, at others it yields. In the latter case, the tumour extends as far as the external angle of the cavity. It is evident then, that here the cause of the dilatation of the sheath, completely or in part, results simply from the less resistance, either of its internal wall, or of the cribriform fascia lata investing it. The lymphatic foramina are then enlarged, the tumour is covered by a plexus of silvery and strong fibres, separated by round and oval spaces, allowing the viscera to protrude.

When the dilatation of the inner wall of the sheath is complete, we find an external tumour placed opposite the pectineus muscle. Being oval-shaped, with its small extremity upwards, nearly touching the edge of Poupart's ligament, at some lines below Gimbernat's ligament, this tumour has the appearance of a swollen gland, rather uneven on its surface. We may easily pass the point of the finger beneath its internal, but not below either its external or inferior, border. This ensues from the femoral portion of the deep layer of the subcutaneous fascia of the abdomen.

Completely invading the internal fossa, the hernial sac may send a prolongation across one of the openings giving passage to the lymphatic vessels, that is to say, by one of the foramina of the cribriform fascia of the sheath. This species of change, in the appearance of the sheath, is far from uncommon. In his researches M. Thomson says, that he has met with them more frequently than with the others. It is not always the same foramen which thus gives passage to the appendix of the protruded sac. We most frequently find it at about two lines beneath the external border of Gimbernat's ligament; we sometimes observe it in the middle of the internal wall of the sheath, sometimes near the saphena. Thomson asserts, that he has found these tumours of all sizes, from that of a large pea to a walnut. They also pass through a foramen, corresponding to the cribriform layer of the fascia lata. Their position and form vary like their size; the sheath re-acts upon them only at their necks, and during constriction.

As these foramina are formed of two series of fibres, some appertaining to the pelvi-crural, others to the ilio-pubic, band, it is manifest that all pressure exercised from within outwards, against the anterior wall of the sheath, will tend to remove the concavity of their respective borders, and thus diminish the area of the ring giving passage to the appended sac. To remove constriction, then, it is unnecessary to cut Gimbernat's ligament; a section upwards and outwards frees the ring better;

two slight incisions, one upwards, the other horizontally outwards, present still greater advantages.

With regard to the taxis here, as in the case where a limited portion of the internal wall of the sheath becomes dilated, every effort to return the tumour upwards and outwards, upwards and backwards, must act contrary to the intention of the surgeon; it is, therefore, better to seize the tumour and knead it beneath the fingers, avoiding any change in position. When the foramen is situated near Gimbernat's ligament, we apparently perceive, after the removal of the sac, that which has been described by Manec, and adopted by Berard, in his article on the groin; that is to say, an external free border and a cribriform septum, between the tumour and the vein. This septum, constituted by that portion of the internal wall of the sheath which remains untouched beneath the dilated foramen, may, when the hernia is very large, be placed against the femoral vein. The tumour, lying, by its outer side, on the cribriform lamella of the sheath, being bound down against this wall by the deep layer of the femoral portion of the subcutaneous fascia of the abdomen, may gradually push the cribriform fascia, and support that portion of the sac which was primitively situated in the inner divisions of the sheath.

Thus, the viscera may protrude into the crural sheath, in two situations; in its external or arterial division, (external crural hernia;) and in its internal or venous division, (internal crural hernia;) and when in the inner division of the sheath, the hernia presents several varieties:—

First. Without dilating the coverings of the canal.

Second. Dilating only its external wall or intervascular septum.

Third. Dilating, at the same time, the internal and anterior walls.

Fourth. Dilating, at the same time, the external, anterior, and internal walls.

Fifth. Dilating solely, but entirely, its internal wall.

Sixth. Dilating a circumscribed portion of its inner wall, generally towards its centre.

Seventh. Dilating one of its foramina, to escape in the form of an appendix. In all these varieties, excepting the last, the tumour is necessarily covered by the walls of the sheath and by the fascia lata.

SECTION NINETEENTH.

ENVELOPES OF HERNIÆ.

Direct herniæ, whilst still retained behind the external inguinal ring.—The envelopes of all direct herniæ, before escaping through the external inguinal ring, are eighteen in number, quite complete, as follows:—1. Skin; 2. Subcutaneous adipose tissue; 3. Superficial layer of the subcutaneous fascia; 4. Dartos; 5. Deep layer of the subcutaneous fascia of the abdomen; 6. Fascia of the crucial fibres; 7. Sheath of the external ring; 8. Internal pillar of the external inguinal ring; 9. Intermuscular fascia of the external and internal oblique; 10. Aponeurosis of the internal oblique; 11. Intermuscular fascia of the internal oblique and transversalis; 12. Aponeurosis of the transversalis muscle; 13. Tendon of the internal oblique and transversalis muscle of the opposite side; 14. The external expansion of the rectus muscle; 15. Fascia propria, or, according to Thomson, fascia transversalis; 16. Expansion of the uracus; 17. Cellular layer of the peritoneum; 18. Serous sac. When the hernia is external to the obliterated umbilical artery, the sixteenth covering is wanting.

Direct herniæ, protruding through the external inguinal ring.—The investments of all direct inguinal herniæ, after having traversed the external ring, are nine incomplete, and four or five complete:—1. Skin; 2. Subcutaneous adipose tissue; 3. Superficial layer of the subcutaneous fascia; 4. Dartos; 5. Deep layer of the subcutaneous fascia; 6. Sheath of the external inguinal ring; 7. Intermuscular fascia of the external and internal oblique; 8. Cremaster muscle; 9. Intermuscular fascia of the internal oblique and transverse; 10. A complete sac, derived from the rectus muscle; 11. A second complete sac, formed by the fascia propria; 12. Spreading of the uracus; 13. A third complete sac, formed by the cellular layer of the peritoneum; 14. The sac constituted by the serous membrane.

When hernia occurs external to the obliterated umbilical artery, the twelfth covering is wanting; if through the separation of the fibres of the external oblique, the tenth covering would also be wanting. But hitherto Thomson has not dissected any such.

Oblique inguinal herniæ, still in the canal, in man.—The coverings of oblique herniæ, contained in the canal, are:—1. Skin; 2. Subcutaneous adipose tissue; 3. Superficial layer of the subcutaneous fascia; 4. Abdominal attachments of the dartos; 5. Deep layer of the subcutaneous fascia; 6. Crucial fibres of the external oblique; 7. Aponeurosis of the external oblique;

8. Intermuscular fascia of the external and internal oblique; 9. Iliac cremaster; 10. Intermuscular fascia of the internal oblique and transversalis; 11. Sheath of the cord coming from that part of the rectus constituting the internal inguinal ring; 12. Fascia propria; 13. Cellular tissue of the peritoneum; 14. The serous sac.

The nine first layers only cover the anterior surface. The 10th, 11th, 12th, and 13th envelope it, excepting at the inferior extremity. The fourteenth alone invests it, like a sac.

Oblique inguinal herniæ in the scrotum.—The coverings of oblique inguinal herniæ, contained in the scrotum, are thirteen, three of which are dense envelopes, nine imperfect, and one true. These are:—1. Skin; 2. Subcutaneous adipose tissue; 3. Superficial layer of subcutaneous fascia; 4. Dartos; 5. Deep layer of subcutaneous fascia; 6. Sheath of the external inguinal ring; 7. Intermuscular aponeurosis of the external and internal oblique; 8. Cremasters; 9. Intermuscular aponeurosis of the internal oblique and transversalis; 10. Sheath of the internal inguinal ring; 11. Sheath of the fascia propria; 12. Sheath of the subperitoneal cellular tissue; 13. Peritoneum.

Herniæ in the course of the round ligament, not having protruded through the external inguinal ring.—To understand this subject, it is necessary to recollect, that the round ligament sends no fibres in the labium majus, and that it is attached to the supra and sub-pubic crests and pubic spine. Having no sheath from the fascia transversalis, it receives one from the purely cellular layer of the peritoneum.

The round ligament, passing between the fasciculi of the internal oblique and transversalis muscles, has certain fibres of these muscles beneath it. This remarkable fact distinguishes the abdominal portion of the inguinal region in the male from that in the female.

The investments of oblique inguinal hernia, which has not protruded through the external inguinal ring, vary from before backwards, according as the hernia occupies the outer half, or the whole of the inguinal canal, in women. In the latter case, there are ten incomplete, and one complete:—1. Skin; 2. Subcutaneous adipose tissue; 3. Superficial layer of the subcutaneous fascia; 4. Abdominal attachments of the fascia of the labium majus, that is, the dartos in females; 5. Deep layer of the subcutaneous fascia of the abdomen; 6. Crucial fibres; 7. External oblique; 8. Intermuscular fascia of the external and internal oblique; 9. Expansion of the fibres of the internal oblique; 10. Intermuscular fascia of the internal oblique and transversalis; 11. Cellular layer of the peritoneum; 12. Peritoneum.

The ten first only cover the anterior surface, the eleventh surrounds it, excepting below; the twelfth alone entirely envelopes it.

In the first case, or where the oblique inguinal hernia, in women, only occupies the outer half of the inguinal canal, the hernia has still another envelope, constituted by the scattered fibres of the transversalis muscle.

Inguino-labial herniæ in women.—When oblique inguinal hernia, in women, has escaped through the external ring, it is covered by,—1. Skin; 2. Subcutaneous adipose tissue; 3. Superficial layer of subcutaneous fascia; 4. Fascia of the labium majus, or the dartos in women; 5. Fascia of the external inguinal ring; 6. Deep layer of the subcutaneous fascia of the abdomen; 7. Intermuscular fascia of the internal and external oblique; 8. Intermuscular fascia of the internal oblique and transversalis; 9. Cellular layer of the peritoneum; 10. Peritoneum.

The four first only cover it in front; the six others entirely invest it.

CHAPTER SECOND.

PELVIS.

SECTION FIRST.

PERINÆUM.

First adipose layer.—Under the skin of the ano-perinæal region, we find, as elsewhere, a layer of coarse fat. This progressively diminishes in thickness, from the sides towards the raphe, as well as in front and behind. An attentive dissection shows, that it is half as thick as the adipose layer placed between the subcutaneous fascia and the inferior aponeurosis of the perinæum; we perceive, also, that it is not uniform, but disposed in irregular layers, following the course of the subcutaneous vessels, and forming a kind of sheath for them; and in thin persons, it has the arborescent appearance of the omentum of some fat animals. It has been said, that there never is fat in the substance of the scrotum, which is an error; in the subject which we examined, the subcutaneous adipose layer could be traced, as far as the middle portion of the posterior wall of the scrotum. This layer, very much thinned, extended, in a subject which M. Thomson examined, over the whole surface of the scrotum.

Superficial subcutaneous fascia.—Immediately above the adipose tissue, we find a layer covering all the ano-perinæal, as well as the adjacent portions of the crural and gluteal, regions. This layer is a portion of subcutaneous fascia, enveloping the two

dartos, as in one common sheath. A careful dissection shows, that its fibres form nearly a right angle with the antero-posterior diameter of the perinæum. From the raphé, they also cross, at a right angle, the direction of the gluteal muscles, which they wind round, from within outwards, and from before backwards, to fix on the spinous processes of the lumbar vertebræ or sacrum, and the whole of the posterior surface of the coccyx. A still more minute examination proves, that they are united into stronger fasciculi near their dorsal attachments; leaving which, they spread from behind forwards, like fans, and interlace on the antero-posterior line of the perinæum, forming a continuous layer having the appearance of an irregularly woven web. It is important to observe, that each spinous attachment spreads out like a fan; that these divers fans dovetail by their neighbouring edges, forming a membrane which, at a few points, may be divided into two, but cannot form two distinct general layers over the region. Those anatomists who have pretended to have found several layers in the superficial fascia of the perinæum, have not examined it through its whole extent, but merely in some circumscribed points. Its fibres spread and interlace, so as to form numberless little foramina, destined for cutaneous vessels, for which purpose they cross before separating: those which were anterior become posterior, and again cross, forming small openings, and resuming their primitive direction. The disposition of the fibres, around the foramina of which we are speaking, is the same as that of the fibres which compose the hernial ring, and the results of the muscular action are the same in both; that is to say, efforts here determine compression of the vessels, as they there cause constriction of the viscera.

This aponeurosis gradually thins as it approaches the anus; there its fibres interlace with the inferior extremities of the longitudinal fleshy fibres of the rectum; where these are reflected outwards, to attach themselves to the lower opening of the true pelvis. Having no tendinous or osseous attachment in the ano-perinæal region, excepting on the extremity of the coccyx, all effusions of blood, urine, or pus, arriving at its superior surface, may extend to the haunches, thigh, and scrotum, without penetrating the dartos.

Second adipose layer.—After raising the superficial layer of the subcutaneous fascia, we find, as everywhere else, a second bed of adipose tissue, the grains of which are more voluminous and less rounded than those of the subcutaneous tissue. This second layer, contrary to what we find in the abdomen, is thicker than the superficial. Its greatest thickness is at the origin of the protuberance of the ischium. From thence it proceeds, thinning in front, behind, to the right and to the left, but more rapidly in front and externally than in the other directions. In front, we trace it as far as the middle of the pos-

terior surface of the scrotum. In the centre of this adipose layer, we remark a packet of nerves and vessels, which are directed from behind forwards, and from without inwards, parallel, and two or three lines inferior, to the ascending ramus of the ischium, to be distributed to the subcutaneous fascia and skin of the posterior portion of the scrotum. This packet is composed of the perinæal branches of the ischiatic vein, artery, and nerve.

Deep subcutaneous fascia.—After having removed the vessels and the second adipose layer, we perceive a fibro-muscular lamella, proper to the perinæum. This, muscular towards the the centre, aponeurotic, white, and silvery towards the borders of the lower opening, is fixed by fan-shaped fibrous processes, imbricated on the external lip of the pubic arch, on the fascia covering the perinæal border of the gluteus maximus, and on the external border of the coccyx. In ordinary subjects, this layer represents a strong aponeurotic membrane in front and behind the rectum. In muscular individuals, on the contrary, it is partly fleshy, almost to its bony insertion. Examined with care, it is evidently formed, in front of the rectum, by the fan-like expansion of the very delicate fibrillæ of the anterior extremities of the anal sphincter, which interlace with the perinæal portion of the dartos, behind the anus, by tendinous expansions, similar to the cutaneous sphincter; laterally, by the fleshy fibres of the cutaneous sphincter, interlaced with the extremities of the longitudinal fibres of the rectum; which, being reflected outwards to become attached to the inferior opening, thus complete this fibro-muscular web.

Separated from the superficial subcutaneous fascia by the second adipose layer, arteries, veins, and ischio-perinæal nerves, this layer covers and completes the encasing of the fatty mass which fills the ischio-rectal cavity, and is prolonged, in front, into the fossæ, in which the perinæal branches of the internal pudic arteries, veins, and nerves ramify. Being continuous, in front, with the dartos, by means of a reciprocal blending of fibres, every effusion extending to it, which does not follow the course of the vessels traversing it, is confined to the ano-perinæal region, and spreads, either into the ischio-rectal fossa, or even into the dartos, by separating from the interior of these sacs the prolongation derived from the deep layer of the subcutaneous fascia of the abdomen.

Cutaneous sphincter of the anus.—The superficial or cutaneous portion of the anal sphincter furnishes, to a great degree, the preceding fibro-muscular layer. It is a mass, flattened from above downwards, about an inch wide in robust individuals, opposite the anus; about two inches and a half wide towards its anterior, and only two inches towards its posterior attachments. Rather more than two lines thick in muscular subjects, opposite the lateral points of the anus, this muscle immediately

diminishes in thickness in all directions. Its fasciculi, terminating in tendinous fibres, which spread out, fan-like, in thin individuals, are sometimes fleshy to the point of insertion in those who are more muscular.

From the summit of the spinous processes, and from the sides of the coccyx, the fibres, directed from behind forwards, traverse, nearly at right angles, the perinæal border of the gluteus maximus, interlace, wind round the anus, and again blend in front of this opening, subsequently spreading into broad aponeurotic fans, to be attached definitively on all the external lip of the pubic arch. Here, as elsewhere, when the subject is muscular, the fleshy fibres extend rather beyond the median line. The anterior extremities of the two muscles, in fixing on the bones, interlace with the perinæal extremities of the dartos, and indigitating with the fibrous attachments of the deep layer of the superficial fascia of the thigh, they form a continuous layer with the scrotum. The fibres, lying on the gluteus muscle, intermingle, in their course towards the coccyx and sacrum, with the fibres of the fascia lata, thus contributing to the formation of that membrane.

The internal border of this muscle is separated from the mucous membrane merely by a thin layer of the longitudinal fibres of the rectum. It is maintained in its horizontal position by the following mechanism: in descending, the longitudinal fibres of the rectum pass between its fasciculi, and, interlacing with them, subsequently curve outwards in all directions, to attach themselves to the inferior margin of the true pelvis, completing the deep layer of the subcutaneous fascia. We must not forget that the most external fibres, relative to the anal margin, are definitively attached near the transverse line of the perinæum, anteriorly and posteriorly. The fibres immediately touching the anus, consequently, meet at a very acute angle before crossing; whence the idea that the sphincter is prolonged into the dartos. We perceive, from the above arrangements, that these muscles can only act on the anus by their inner border; and from their relations with the longitudinal fibres of the rectum, it follows, that the latter are the true antagonists to the cutaneous sphincter.

Deep sphincter of the anus.—Upon raising the deep perinæal fascia, we find, on each side of the rectum, a series of fleshy fasciculi placed one above the other, and constituting, collectively, a sphincter, from six to nine lines high, and two to three thick. These, when arrived at the median line, anterior and posterior to the intestine, interlace, and change sides. By a sort of half twist, from above downwards, and within outwards, they finish by spreading horizontally, the inferior becoming posterior, and the superior anterior, in front of and behind the rectum. Ordinarily fleshy, as far as the median line, almost as far as their bony attachments, in very muscular subjects, they

are, on the contrary, tendinous before reaching that line, in emaciated persons. They then, by their interlacements, constitute a fibrous raphé, and by their blending and superposition, a fibrous lamella, triangular in front; which layer I have described as the fibro-cartilaginous recto-bulbous process, forming the point of origin or union of all the muscles and aponeurosis of the perinæum and urethra. When the fleshy fibres extend beyond the median line, this does not exist. In front of the anus these fibres are attached to the inner lip of the pudic arch. There they fold to form a sheath for the vessels and nerves.

In the posterior half, that is to say, as far as the point of union of the ascending ramus of the ischium and descending ramus of the pubes, this sheath only contains the external branch of the perinæal nerve. In its anterior half it contains the prolongation of this nerve with the circumflex branches of the thigh, which proceed to form the vessels of the membrane investing the internal surface of the dartos, and coming from the deep layer of the abdomen. This, in attaching itself to the descending ramus of the pubes, mingles with the aponeurotic layer resulting from the anterior expansion of the sphincter muscles. The posterior extremities of these fibres are inserted on the anterior and lateral portions of the coccyx, subsequently on the perinæal margin of the sacro-sciatic ligament. In front, as well as behind, they are interlaced with longitudinal fibres of the rectum, which, being reflected outwards, are attached to the whole of the inferior opening of the true pelvis.

Ano-scrotal aponeurosis.—A portion of the sphincter of the anus is thus converted into a fibro-muscular membrane, which covers all the inferior surface of the ano-perinæal region. Continuous with the internal sheath of the dartos, and separated from the deep layer of the subcutaneous fascia by a considerable quantity of fat, this membrane is fixed to the whole of the median line, by a mechanism which we shall presently describe. Between it and the ano-perinæal aponeurosis there are two sheaths, one on each side, containing the superficial perinæal nerve and vessels, and communicating, posteriorly, with the schio-rectal fossa, and, anteriorly, with the internal sac of the dartos.

When the urine arrives at the upper surface of this membrane, it may infiltrate, either in the ischio-rectal fossa, the scrotum of the corresponding side, or between the deep layer of the subcutaneous fascia of the abdomen and the sheath of the cord coming from the inguinal ring. We may, also, imagine that the fluid may thence ascend over the corresponding side of the abdomen to the base of the chest, and insinuate itself between the first and second aponeurotic sheaths of the penis, without passing to the other side.

Accelerator urinæ muscle.—This muscle is composed of three layers of fibres; the first, longitudinal, arises from the subspinal

crest of the pubes, descends towards the root of the penis, interlaces with its fellow, to reach the external surface of the cavernous body of the opposite side, which it crosses from before backwards, and without inwards, before spreading over the bulb: this is the compressor of the bulb and cavernous body. The second layer, or the transverse compressor of the bulb, proceeds from the rami of the pubes, on the sides and inferior surface of the bulb. The third is formed of fibres, as it were, fixed beneath the bulb, which they surround in a spiral manner, to interlace above, and constitute a portion of the suspensory ligament of the penis. All this mass is destined to compress the bulbous portion of the urethra, and draw it towards the symphysis.

Erector penis muscle.—We find two orders of fibres in this muscle, which, attached to the internal lip of the ramus of the ischium, pass spirally beneath the crus penis, which they surround, and terminate on the external lip of the ramus of the pubes. The other, placed longitudinally, arise nearer the tuber ischii, spread out over the crus penis, and terminate in the fibrous tunic of that organ.

Transversalis perinæi.—This is merely a small ribbon-like fasciculus, extending from the tuber ischii towards the root of the bulb, to interlace with its fellow, and fix itself on the inner lip of the ramus of the pubes. It has been confounded with that of another plane, formed of oblique fibres in the opposite direction; that is to say, coming from the ramus of the ischium, a little behind, to interlace on the median line, above the bulbo-rectal muscle. This is Santorini's muscle, or the anterior ischio-rectal of Thomson. It forms a portion of that which I have termed *middle aponeurosis.*

Bulbo-rectal muscle.—The small ribbon, called *bulbo-rectal* by Thomson, passing from the front and sides of the anus towards the bulb, to reach the symphysis pubis, after encircling the termination of the membranous portion of the urethra, is nothing more than the summit or inferior portion of Santorini's muscle; its direction is the same as that of the longitudinal plane of the erector penis. Drawing the bulb backwards, it antagonizes the latter when it contracts.

Ano-perinæal aponeurosis.—Formed by the expansion and transformation of some of the fibres of the preceding muscles, and of those which we shall presently describe, this aponeurosis invests the inferior surface of the acceleratores urinæ, erectores penis, and transversi perinæi muscles, which it separates from the ano-scrotal aponeurosis.

Subpubic ligament.—Placed immediately beneath the symphysis, between the rami of the pubes, this ligament is quadrilateral; its two sides are each a quarter of an inch long; its anterior margin three lines, and continuous with the lower border of the fibro-cartilage of the symphysis: its posterior margin serves

as a guide for the point of the sound. Like almost all the organs occupying the median line, it is double. An attentive examination shows that it consists of two lamellæ: each of these is attached, on the one hand, to the two posterior thirds of the ramus pubis, and, on the other, to the two anterior thirds of the opposite side. They consist of nearly parallel fibres, directed from before backwards, crossing those of the opposite side, and frequently interlaced with them, like the threads in a web; the fibres, arising posteriorly, descend in a spiral direction, crossing those of the opposite side, and winding round them to pass forwards, in surrounding the inferior border of the mass. The surfaces of this ligament are covered by the splitting of the ano-pubic aponeurosis, separating it from the dorsal vessels and nerves of the penis. It is in contact, by the centre of its posterior surface, with the pubio-vesical venous sinus, externally with the origins of Wilson's muscles, and still more externally with the fibres of the bladder, which constitute the aponeurosis, separating Wilson's muscles from the levatores ani.

Ischio-pubic ligaments (Thomson).—*Portion of the ano-pubic aponeurosis.*—There are two ischio-pubic ligaments; each of these unites the ascending ramus of the ischium to the descending ramus of the pubes of the opposite side. Appearing like aponeuroses, they are quadrilateral, and compressed from above downwards, presenting two free borders; one anterior, half an inch, the other, posterior, about an inch and a half long; and two fixed borders; one an inch and a quarter, and the other about four fifths of an inch. Their fibres, successively shorter, less oblique, and more delicate from behind forwards, arisé from the anterior portion of the ischium. Passing, forwards and inwards, towards the median line, their posterior fibres interlace, and implant themselves on the descending ramus of the pubes of the opposite side. We thus perceive that the ischiatic border of this ligament is the longest, and subsequently, also, that its posterior margin crosses it at a right angle, which reposes on the bulbous portion of the urethra. We shall, also, observe that the posterior edges of the ischio-pubic ligaments are cut at right angles by the anterior edges of the two ligaments, which concur in forming the *middle aponeurosis of the perinæum.* From the intersection of the posterior border of these ligaments among themselves, and from their intersections by the anterior edges of the muscles in question, there results a quadrilateral opening, embracing the membranous portions of the urethra, immediately above and behind the bulb. The point of union of these two edges is at seven lines from the subpubic ligament, or fifteen from the symphysis. The two ischio-pubic ligaments form a mass, which fills all that space comprised between the membranous portion of the urethra and the posterior margin of the subpubic ligament. This mass is perforated by four foramina, two on each side. The internal of these is placed immediately behind the posterior

border of the subpubic ligament, close to the median line, and gives passage to one of the two branches of the dorsal vein of the penis. The external is at two lines external and posterior to the other, giving passage to the dorsal nerve of the penis. These foramina are oval, having their long diameter parallel to the course of the fibres of the ligament of the opposite side. Being less tense from before backwards, in the space comprised between the urethra and the subpubic ligament, all bodies pressing along the median line, from before backwards, render its inferior surface concave, and tend to complete the kind of groove already commenced on the inferior surface of the subpubic ligament, conducting towards the opening traversed by the urethra.

Since the mass resulting from the union of these two ligaments is not completely tense, and that it gradually becomes less so posteriorly, it is manifest that the point of a catheter, conducted along the median line with gentle pressure, would arrive directly in the membranous portion of the urethra.

The foramina, described above, being directed obliquely from before backwards, during the contractions of the abdominal muscles and diaphragm, the vessels are then so much compressed that the venous circulation of the corpora cavernosa and a portion of the bulb is interrupted. Hence, in some cases, as in violent constipation, the ischio-pubic ligament may contribute to the erection of the penis, which then effectively occurs.

The 'foramen, traversed by the membranous portion of the urethra, completed, posteriorly, by two muscles, offers, in front, a resistant margin, against which these muscles may compress the urinary canal.

Anterior ischio-rectal muscles (Thomson).—*Portion of the transversus perinæi.*—This muscle, compressed from above downwards, situated between the membranous portion of the urethra and the rectum, is irregularly quadrilateral,—almost rhomboidal. Its anterior side is nearly twenty lines long, the posterior two inches; its external an inch and three quarters, and its internal an inch and a half. From about two lines thick, in the fleshy portion of its posterior margin, it becomes gradually thinner in front. It arises, by very short tendinous fasciculi, from the whole of the inferior lip of the ascending ramus of the ischium, above the origin of this portion of the accelerator urinæ, which M. Thomson proposes to name the *transverse compressor of the bulbous portion of the urethra;* but in no way from the descending ramus of the pubes. Of its tendinous fasciculi of origin, some are above, others below, the internal pudic and deep-seated vessels. The fleshy fasciculi, which succeed the tendinous origin, are directed more backwards as they approach the anterior border. All its fibres arrive at the median line, between the supra-bulbous portion of the urethra and anus. There they interlace with those of the opposite

side, and fall on the anterior surface of the rectum. They then again become tendinous, after spreading out and interlacing with the inferior extremities of the levator ani. The anterior border meets that of its fellow nearly at right angles, open anteriorly, in which reposes the posterior half of the supra-bulbous portion of the urethra. This margin also traverses the posterior border of the ano-pubic aponeurosis, at two or three lines from the raphe, so that their approximation and their intersection by the ischio-pubic ligaments produce a quadrilateral foramen, destined for the passage of the membranous portion of the urethra, which may thus be compressed against the resistant margins of the ischio-pubic ligaments.

These muscles, at their origin, are, as may be said, divided into two lamellæ, receiving, between them, the root of the ischio-pubic ligament. With the ano-pubic aponeurosis and the subpubic ligament, they produce a complete plane, filling all the pubic arch. Forming the base of the central aponeurosis of the perinæum, they are situated immediately above the accelerator urinæ muscles, from which they are separated by the tendinous insertions, firstly, of the bulbo-rectal, and,secondly, of that which Thomson calls the *common compressor of the cavernous bodies, and of the bulbous portion of the urethra.* Its inferior surface, separated, laterally, from the levator ani by the tendinous fibres of the bladder, is in contact with the rectal attachments of Wilson's muscle; its inferior surface corresponds to Cowper's glands. It must be intended to draw the anterior portion of the anus upwards and forwards, and to prevent, not only the passage of urine from the bladder, but also its return, and that of the semen, when once arrived at the bulbous portion of the urethra. By its spasmodic contraction it may also oppose the introduction of a catheter. Does not the difficulty, which we frequently experience in the operation of catheterism, when the point of the instrument passes along the inferior wall of the urethra, proceed from this?

Compressor urethræ muscle (Thomson).—*Portion of the accelerator urinæ.*—This muscle, long and narrow, lies between the bulb of the urethra, the ano-pubic aponeurosis, and the anterior ischio-rectal muscle. In its superior half, situated between the crura penis, it is compressed laterally; inferiorly, it is compressed from above downwards. In its greatest diameter, which we find near the commencement of the membranous portion of the urethra, it is only three lines transversely. It arises by two delicate fibrous fasciculi from the antero-inferior border of the symphysis pubis. Its fibres converge from above downwards, and soon constitute a thin tendinous lamella, which forms, with that of the opposite side, the posterior portion of the suspensory ligament of the penis. Its fasciculi, at its origin, interlace, not only with those of the opposite side, but also with the tendinous fibres of the erector penis muscle, between the two

corpora cavernosa, and as far as the superior surface of the urethra. Arrived there, they become fleshy, surround the inferior part of the membranous portion of the urethra, which they touch only by their posterior border, close to the bulb. Beneath the urethra they again interlace with those of the opposite side, again become tendinous, form an expansion, like a fan, of which the fibres mingle with those of the anterior portion of the levator ani. It is between the two divisions of their tendinous origin, that the supra-pubic funnel, already described, extends. The outer surface of this tendon is in contact with the tendinous insertion of Thomson's *bulbo-rectal* muscle. Beneath the cavernous bodies the surface, which was external, becomes superior, and corresponds to the inferior surface of the corpus spongiosum urethræ by a plexus of cavernous veins. More inferiorly and externally, it is in contact with the sheath of the bulb and the superior border of the fleshy portion of the recto-bulbous muscle.

These muscles are evidently destined to compress the urethra, and its membranous portion, immediately below the plane formed by the union of the ano-pubic aponeurosis and the anterior ischio-rectal muscles. It is important to note that, as they only touch the urethra by their edges, they compress this organ by raising its walls, like transverse valves. Although the origin and course of these muscles are the same as a portion of the accelerator urinæ, it must not the less be distinguished from them, as their functions are manifestly different. They compress the membranous, instead of the bulbous, portion of the urethra, and are thus the antagonists of all the portions of the mass named *bulbo-cavernous*.

Wilson's muscle.—This muscle is immediately above the subpubic ligament of the ano-pubic aponeurosis, and of the perinæal portion of the levator ani, about two inches long, three lines broad, and half or three quarters of an inch thick, in the middle of its fleshy portion, compressed laterally. It arises by several isolated tendinous fasciculi, interlacing with the tendinous fasciculi of the origin of the prostatic and vesical muscles. Attached to the superior half of the ramus of the pubes, above the subpubic ligament, they are directed backwards, downwards, and inwards, towards the median line, where they blend with those of the opposite side, in front of the membranous portion of the urethra. Immediately after having traversed the median line, and being applied to the opposite side of that portion of the urethra, they again encounter the fibres of the opposite side, and return whence they started, to be implanted on the anterior surface of the rectum, by interlacing with its proper vertical fibres.

The space separating the origin of these muscles is occupied by the inferior border of the prostatic and vesical muscles, and by the subpubic venous sinus. Inferiorly, it is filled by the

anterior blending of two other muscles. The fibres are here arranged so as to present three distinct venous orifices; one for the supra-bulbous nerve, the other two for the posterior branches of the dorsal vein of the penis. On each side, two lines below the two tendons, and above three lines posterior to their bony attachments, is a foramen, larger than the others, for the passage of the internal pudic vein into the subpubic sinus. These foramina are oval-shaped, having their great diameter from before backwards, parallel to the direction of the tendinous fibres, which tightly embrace the veins, and intimately adhere to their tunics. Hence, when we stretch these fibres backwards, in order to imitate the effect produced by the contraction of the two muscles, the venous orifices are so compressed as to become almost linea.

Wilson's muscles are evidently separated from the subpubic portion of the levator ani by a prolongation of the inner layer of the pelvic fascia; which, passing between them from the posterior border of the subpubic to the posterior portion of the urethra, turns outwards, and fixes on the pubic arch; thus forming the superior fold of the three layers, entering into the composition of Camper's ligament: this aponeurosis belongs to the terminating fibres of the bladder.

These muscles are very difficult to dissect, because, in their fleshy portions, their fibres cross at right angles, and interlace with those of the bladder. Compressing the membranous portion of the urethra below the prostate, they act indirectly as elevators of the anterior and inferior of the rectum. By compressing all the veins proceeding from the internal pudic dorsal vein of the penis and the bulbs, they may retard or prevent the return of blood from the penis, that is to say, the blood of the cavernous and spongy bodies, and contribute with the ischio-pubic ligaments to maintain erection. By compressing the membranous portion of the urethra, they may empty it of urine, semen, &c., prevent their reflux, clasp and arrest the catheter in irritable individuals, and constitute spasmodic constriction of the urethra.

Beneath Wilson's muscle and the middle aponeurosis, there is another similar muscle; it proceeds from the symphysis pubis, descends in the space between the cavernous bodies surrounding the supra-bulbous part of the membranous portion of the urethra, and, after crossing on the median line, terminates on the anterior surface of the rectum. This is the fasciculus which I have described as the *compressor urethræ*.

Taken posteriorly, I shall describe it thus: we find, on the anterior surface of the borders of the coccyx, and the two last pieces of the sacrum, two fleshy ribbons, which, arriving behind the rectum, cross and envelope this intestine like a sphincter, again to cross in front, between the latter and membranous portion of the urethra, fixing, definitively, on the contour of the pubic arch.

The tendinous origins of these two muscles are, the posterior portion of what M. Denonvillier has described as the proper suspensory ligament of the urethra in the following terms:—"The urethra has a proper suspensory ligament, which, arising "from the anterior portion of the symphysis pubis, descends "between the two cavernous bodies, and spreads over the urethra, "where it traverses the middle perinæal aponeurosis. On the "two surfaces of this ligament, the deepest posterior fibres of the "accelerator urinæ muscle are implanted, which thus form, "round the urethra, a contractile ring, attached by its upper "portion."

Summary.—We find in the perinæum,—

1. Skin.
2. Adipose tissue.
3. Subcutaneous superficial fascia.
4. A second adipose layer.
5. Deep subcutaneous fascia, continuous with the superficial sphincter.
6. Ano-scrotal aponeurosis, continuous with the deep sphincter.
7. Ano-penial aponeurosis, continuous with other fibres of the deep sphincter.
8. Acceleratores urinæ, erectores penis, transversi perinæi muscles, the bulb of the urethra, the root of the penis.
9. The musculo-fibrous mass, known as middle aponeurosis (ano-pubic), and which comprehends the ischio-pubic ligament, some of the compressor muscles of the urethra, some of the transversi perinæi or anterior ischio-rectal, and Wilson's muscles.
10. Mingled with these, the longitudinal fibres of the rectum, which spread out and diverge to be lost in the fasciæ, and thus fix around the inferior opening.

SECTION SECOND.

PELVIC CAVITY.

Fascia pelvica.—Formed by the tendinous origins of the levatores ani muscles, by the termination of some reflected fibres of the longitudinal muscular plane of the bladder and rectum, the pelvic aponeurosis is inserted on the posterior and internal border of the thyroid foramen, from the inferior portion of the symphysis to opposite the cotyloid cavity; where they present an opening, which is the pelvic orifice of the obturator canal. Beyond the thyroid foramen, this aponeurosis is attached, on the internal surface of the cotyloid cavity, almost as far as the sacro-iliac articulation, along the upper opening. Arrived there, it descends on the internal lip of the anterior portion of the great sciatic notch, continuous with the upper border of the little sacro-sciatic liga-

ment, and raising itself over the internal surface of the pyramidalis muscle, so as to fix definitively on the anterior of the sacrum, external to the sacral foramina.

Ischio-pubic band.—The pelvic aponeurosis is, as it were, divided into two halves, external or iliac, internal or recto-vesical, by a sort of ribbon, extending from the summit of the spine of the rectum to the inner border of the thyroid foramen. This band which I have called *ischio-pubic*, is only the tendon of the sacro-pubic portion of the levator ani muscles.

Ilio-pelvic aponeurosis.—The iliac portion of the pelvic aponeurosis corresponds to the superior half of the internal surface of the obturator muscle. The pubic vessels and nerves pass through it. It is reflected, inferiorly, on the internal border of the pubic arch, being continuous with the great sacro-sciatic ligament, so as to complete the sheath of the internal obturator muscle; posteriorly, it covers the internal surface of the pyramidalis muscle.

Recto-vesical aponeurosis.—The internal or recto-vesical portion, thinner than the preceding, is so united by its inferior surface to the levator ani, that it is sometimes completely muscular. It extends from the summit of the pubic arch to the union between the fourth and fifth pieces of the sacrum, and spreads over the sides of the bladder and rectum.

Levator ani.—The fibres of this muscle arise from the fissure uniting the recto-vesical with the obturator portion of the pelvic aponeurosis, or of the ischio-pubic band; then, from all the inferior surface of the recto-vesical aponeurosis, to proceed to the following points:—

The *coccy-pubic portion*, or the most elevated, of its fibres, leaving the inner surface of the corresponding pubes, follow nearly the direction of the ischio-pubic band. Arrived opposite the ischiatic spine, it inclines inwards and downwards, as if to continue with the anterior of the lesser sacro-sciatic ligament, and to blend, in front of the coccyx, with the similar fasciculus of the opposite side.

A second portion, or *sacro-pubic*, of this muscle descends from the internal and superior contour of the thyroid foramen, over the sides of the membranous portion of the urethra, so as to interlace in front of the rectum, and surround this intestine above the sphincter, and fix, after again interlacing, on the last piece of the sacrum.

The other fleshy fibres of the levator ani appear to rise from the *ischio-pubic* band, to proceed obliquely downwards, backwards, and inwards, on the sides and posterior portion of the rectum, where they blend, and are inserted on the sides of the coccyx, intermingling with the fibres of the lesser sacro-sciatic ligament.

The most remote portion of the levator ani, which appears con-

tinuous with the lesser sacro-sciatic ligament, is merely the muscle vulgarly called *coccygeus.*

We must add, that the *longitudinal fibres of the bladder*, arrived near the urethra, are reflected in diverging, to interlace, external to the ischio-pubic band, with the sacro-pubic portion of the levator ani muscle, at the same time that others extend into the ilio-pelvic aponeurosis, which they concur in forming, as if to fix themselves on the upper opening. Similar fibres escape from the longitudinal plane of the rectum, to interlace with the coccy-pubic portion, and concur in the formation of the same aponeurosis, by attaching themselves, like the preceding, on the upper opening.

Santorini's muscle.—Below, and in front of the coccy-pubic portion of the levator ani, we perceive a small fan, which, converging, proceeds from the internal lip of the pubic arch, towards the anterior of the rectum, to be reflected behind, and then beneath the middle aponeurosis of the perinæum. Directed forwards, it passes across the fibres of the accelerator urinæ, and becomes aponeurotic, by interlacing on the median line and the posterior portion of the bulb; it then ascends on the sides of the urethra, between the urethra and the crura penis, and fixes, by again crossing, on the anterior surface of the subpubic ligament and symphysis. It thus concurs in the formation of the superior ligament of the penis.

We remark, besides, on the external surface of the pelvic aponeurosis, a series of fleshy fibres, which appear to constitute the obturator portion of that aponeurosis. Rising from the superior margin of the thyroid foramen, these fibres descend perpendicularly, and cross those of the levator ani and the internal obturator, to arrive on the sides of the middle aponeurosis, and continue with the falciform expansion of the great sacro-sciatic ligament. This plane, crossed by the ischio-pubic band, binds down the internal obturator muscle.

Bladder.—All the fibres of the bladder appear derived from the uracus and the rectus muscle of the abdomen, in the neighbourhood of the umbilicus. They present the form of large irregular planes, which may be divided into six fans; three for the right, and three for the left. Of these, one, placed, at first, in front, descends gradually, turning over the side, to reach the external surface of the bas-fond, the larger part passing between the two ureters. There its fibres cross, proceeding to the neck; those of the right being on the left, and vice versâ; thence we may perceive them assembled into two fasciculi, gradually becoming more marked, some lines thick, and fixing on the posterior and inferior portion of the symphysis pubis, after again crossing. The second of these patches descends, almost perpendicularly, over the anterior surface of the bladder. The interlacing of this second order of fibres commences at the middle of the

summit of this organ, and continues to below. After this, crossing inferiorly, several of them are reflected to be inserted on the posterior of the symphysis, constituting the anterior ligaments of the bladder. The others pass to the sides of the neck, interlacing with some of the fibres of the preceding, to be reflected between the bas-fond and the rectum, and concur in the formation of the pelvic aponeurosis, by intermingling with the fibres of the levator ani. The third layer descends spirally, from the left side, to the posterior, afterwards to the right lateral, portion. Its fibres pass partly to the exterior of the ureters, approaching near the neck, and forming a prominent fasciculus, which appears flattened against the external surface of the plane first indicated, to be prolonged to the posterior, inferior, and external surface of the symphysis pubis, by again crossing.

More and more multiplied, in proportion as they approach the ureters, the fibres of the preceding become more firm when they arrive in the trigone; where they at first converge, and then cross at the commencement of the urethra, finally dividing into three planes; one spreading in the ano-pubic aponeurosis, below the muscle of the prostate; the other extending in front of Wilson's muscle, to be attached at the inferior opening; and the third, which is prolonged round the urethra as far as the gland. Hence, the fibres of the bladder terminate like those of the rectum. Many of them, taking their fixed point on the inferior opening, may dilate the muscle of the prostate and Wilson's muscle, at the same time that they close the orifice of the urethra. The ureters are engaged in a kind of button-hole, formed by the crossing of the corresponding borders of the first and third plane. It, also, results that the neck of the bladder is enclosed in another much stronger, and constituted by the interlacing of the fibres of the first plane from behind forwards, and by those of the second from before backwards. It is according to this disposition, that we may endow the neck of the bladder with a true sphincter.

Muscle of the prostate.—Below, and within the pubic attachments of the fibres of the bladder, we see other fleshy fasciculi, which, directed backwards, soon cross, envelope the sides of the prostate, re-cross posteriorly, interlace with the longitudinal fibres of the rectum, and cross, for the last time, to be attached on each side of the median line of the inferior portion of the sacrum.

More inferiorly, and nearer the median line, is Wilson's muscle, which is directed, and crosses exactly, in the same manner, by passing round the membranous portion of the urethra, and a rather inferior ring of the rectum.

We perceive that, without reckoning the superior sphincter of M. Nellaton, the end of the rectum is surrounded by a large

number of constrictor rings, which are, from above downwards,—

1. Coccy-pubian muscle.
2. Sacro-pubic portion of the levator ani.
3. Muscle of the prostate.
4. Wilson's muscle.
5. Muscle of the middle aponeurosis.
6. Inferior compressor urethræ muscle.
7. Deep sphincter.
8. Superficial sphincter.

We see also that, instead of dilating the anus, the levator ani can only constrict this opening and the longitudinal fibres of the intestine, antagonists of the preceding alone perform the office of a dilating muscle.

Lastly, we perceive, by this distribution of the fleshy fibres, that, in the operation, whether for fistula or fissure, the incision necessarily divides the fibres of the levator ani, instead of passing between them, as I at first imagined. Incisions of the urethra are alone exceptions.

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G.

H.

T.

FINIS.

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ERRATA.

The words Eustachian, Meibomian, &c. should have been commenced with capital letters.

Page 66, line 10, *for* feramen *read* foramen
88, — 44, for *rotunda* read *rotundum*
103, — 37, *for* pyrotidean *read* parotidean
125, — 22. 25, *for* supra-scapula *read* supra-scapular
161, — 6, *for* Dupuyilen *read* Dupuytren
162, — 4, *for* Cuiveilher *read* Cruveilhier
173, — 31, *for* mammæ *read* mamma
180, — 47, *for* phthisises *read* phthisis
190, — 13, *for* in any *read* any
238, — 11, *for* iliac into *read* into
238, — 12, *for* fossa *read* iliac fossa
251, — 39, *for* cholidicus *read* choledocus
258, — 4, *for* Brumer's *read* Bruner's
278, — 25, for *Highmoreanum* read *Highmorianum*
286, — 22, for *Aponeuroses,* described read *Aponeuroses.*—Described
342, — 14, *for* with *read* without
364, — 41, *for* to *read* on
415, — 38, *for* and pass *read* pass
437, — 39, *for* poplitial *read* popliteal
443, — 39, *for* Mance *read* Manec